

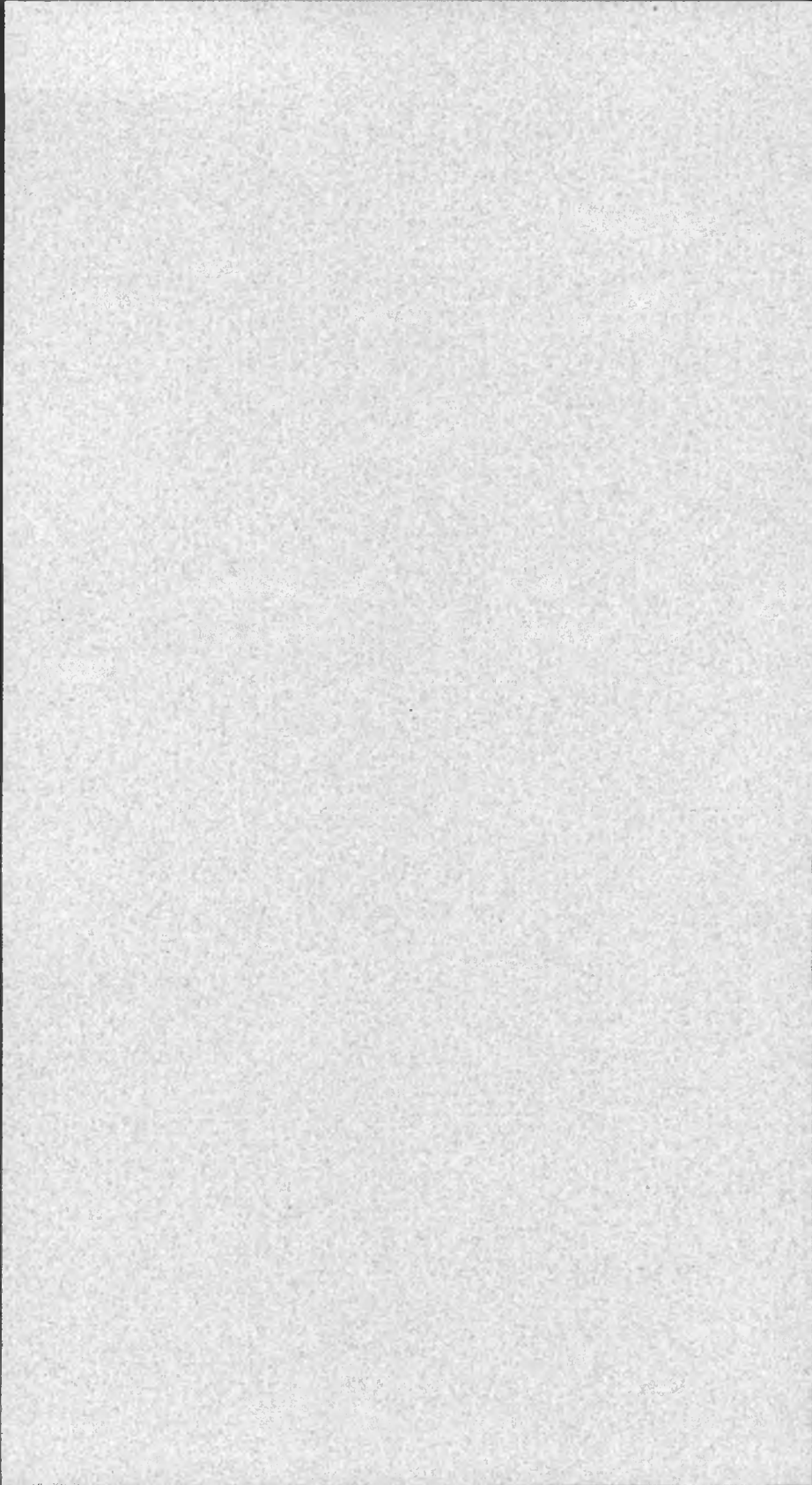


Cornell  
University

ANNOUNCEMENTS

Graduate School of  
*Medical Sciences*

1968-69



Cornell University

Graduate School of  
Medical Sciences

1968-69

1300 York Avenue  
New York, New York 10021  
Telephone: TRafalgar 9-9000

# Calendar\*

## FALL SEMESTER

1968-1969

Registration	Sept. 6, 9
Opening Exercises, 3:30 P.M.	Sept. 9
Instruction begins for first trimester and fall semester	Sept. 10
Election Day, holiday	Nov. 5
End of first trimester	Nov. 22
Examinations for first trimester	Nov. 25-30
Thanksgiving Day, holiday	Nov. 28
Instruction begins for second trimester	Dec. 2
Christmas recess: instruction ends, 5:00 P.M.	Dec. 20
Last day for completing all requirements for January degrees	Dec. 31
Instruction resumes, 9:00 A.M.	Jan. 6
Language examinations	Jan. 6
Fall semester ends	Jan. 31

## SPRING SEMESTER

Registration	Feb. 3-4
Instruction begins for spring semester	Feb. 3
End of second trimester	Feb. 28
Examinations for second trimester	Mar. 3-15
Instruction begins for third trimester	Mar. 17
Spring recess: instruction ends, 5:00 P.M.	Apr. 11
Instruction resumes, 9:00 A.M.	Apr. 21
Language examinations	Apr. 21
Last day for completing all requirements for June degrees	May 14
Memorial Day, holiday	May 30
Commencement, 3:00 P.M.	June 3
End of third trimester and spring semester	June 6
Examination for third trimester	June 9-10

## SUMMER

Summer research period begins	June 11
Registration for summer research	June 11
Last day for completing all requirements for September degrees	Aug. 23
Labor Day, holiday	Sept. 1
Summer research period ends	Sept. 5

\* Courses in the Graduate School of Medical Sciences are either semestral or trimestral. The calendar for this School is based primarily on the academic semester but is coordinated as well with the trimestral calendar of the Medical College.

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The courses and curricula described in this Announcement, and the teaching personnel listed therein, are subject to change at any time by official action of Cornell University.



# GRADUATE SCHOOL OF MEDICAL SCIENCES

## UNIVERSITY ADMINISTRATION

James A. Perkins, President of the University.  
Dale R. Corson, University Provost.  
Mark Barlow, Jr., Vice President for Student Affairs.  
Stuart M. Brown, Jr., Vice President for Academic Affairs.  
John E. Burton, Vice President—Business.  
Lewis H. Durland, University Treasurer.  
W. Keith Kennedy, Vice Provost.  
Franklin A. Long, Vice President for Research and Advanced Studies.  
E. Hugh Luckey, Vice President for Medical Affairs.  
Thomas W. Mackesey, Vice President for Planning.  
Paul L. McKeegan, Director of the Budget.  
Robert D. Miller, Dean of the University Faculty.  
Steven Muller, Vice President for Public Affairs.  
Arthur H. Peterson, University Controller.  
Neal R. Stamp, Secretary of the Corporation, and University Counsel.

## OFFICERS OF ADMINISTRATION OF THE GRADUATE SCHOOL OF MEDICAL SCIENCES

James A. Perkins, A.B., Ph.D., *President of Cornell University.*  
W. Donald Cooke, B.S., M.S., Ph.D., *Dean of the Graduate School of Cornell University.*  
John E. Deitrick, B.S., M.D., *Associate Dean of the Graduate School of Medical Sciences.*  
Julian R. Rachele, B.A., M.S., Ph.D., *Assistant Dean of the Graduate School of Medical Sciences.*

## FACULTY

### Emeritus Professors

McKeen Cattell, M.D., Professor of Pharmacology, Cornell University Medical College.  
Gilbert Dalldorf, M.D., Professor of Pathology, Sloan-Kettering Division.  
Vincent du Vigneaud, Ph.D., Professor of Biochemistry, Cornell University Medical College.  
Dayton J. Edwards, Ph.D., Professor of Physiology, Cornell University Medical College.  
Harry Gold, M.D., Clinical Professor of Pharmacology, Cornell University Medical College.

## 6 FACULTY

Joseph C. Hinsey, Ph.D., Professor of Neuroanatomy, Cornell University Medical College.

Charles V. Morrill, Ph.D., Professor of Anatomy, Cornell University Medical College.

Eugene I. Opie, M.D., Professor of Pathology, Cornell University Medical College.

Wilson G. Smillie, M.D., Professor of Public Health, Cornell University Medical College.

Fred W. Stewart, M.D., Professor of Pathology, Sloan-Kettering Division.

## Professors

M. Earl Balis, B.A., M.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.

Aaron Bendich, B.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.

Oscar Bodansky, A.B., M.A., Ph.D., M.D., Professor of Biochemistry, Sloan-Kettering Division.

Arthur Whitley Branwood, M.B., Ch.B., M.D., Professor of Pathology, Cornell University Medical College.

George B. Brown, B.S., M.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.

Liebe F. Cavalieri, B.S., M.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.

Hirsh G. Cohen, Ph.D., Visiting Professor of Biomathematics, Graduate School of Medical Sciences.

John T. Ellis, B.A., M.D., Professor of Pathology, Cornell University Medical College.

Frank W. Foote, Jr., B.A., M.D., Professor of Pathology, Sloan-Kettering Division.

Jack J. Fox, B.A., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.

Gerhard H. Giebisch, M.D., Professor of Physiology and Biophysics, Cornell University Medical College.

Roger L. Greif, B.S., M.D., Professor of Physiology and Biophysics, Cornell University Medical College.

Milton Helpern, B.S., M.D., Visiting Professor of Pathology, Cornell University Medical College.

Frank L. Horsfall, Jr., B.A., M.D., C.M., F.D. (h.c.), LL.D., D.Sc., Professor of Medicine, Cornell University Medical College; Professor of Microbiology, Sloan-Kettering Division; president and director, Sloan-Kettering Institute, and director, Sloan-Kettering Division.

Aaron Kellner, B.A., M.S., M.D., Clinical Professor of Pathology, Cornell University Medical College.

John G. Kidd, B.A., M.D., Professor of Pathology, Cornell University Medical College.

Edwin D. Kilbourne, B.A., M.D., Professor of Public Health, Cornell University Medical College.



- John S. Laughlin, A.B., M.S., Ph.D., Professor of Biophysics, Sloan-Kettering Division.
- Joel L. Lebowitz, Ph.D., Visiting Professor of Biomathematics, Graduate School of Medical Sciences.
- Walsh McDermott, B.A., M.D., Livingston Farrand Professor of Public Health, Cornell University Medical College.
- Alton Meister, S.B., M.D., Israel Rogosin Professor of Biochemistry, Cornell University Medical College.
- Robert C. Mellors, B.A., M.A., Ph.D., M.D., Professor of Pathology, Cornell University Medical College.
- Walter Modell, B.S., M.D., Professor of Pharmacology, Cornell University Medical College.
- George E. Murphy, A.B., M.D., Professor of Pathology, Cornell University Medical College.
- Mary L. Petermann, A.B., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.
- Frederick S. Philips, B.A., Ph.D., Professor of Pharmacology, Sloan-Kettering Division.
- Robert F. Pitts, B.S., Ph.D., M.D., Professor of Physiology and Biophysics, Cornell University Medical College.
- Julian R. Rachele, B.A., M.S., Ph.D., Professor of Biochemistry, Cornell University Medical College.
- Walter F. Riker, Jr., B.S., M.D., Professor of Pharmacology, Cornell University Medical College.
- Sol I. Rubinow, B.S., M.S., Ph.D., Professor of Biomathematics, Graduate School of Medical Sciences.
- F. Kingsley Sanders, D. Phil., Professor of Cell Biology, Sloan-Kettering Division.
- William F. Scherer, M.D., Professor of Microbiology, Cornell University Medical College.
- Martin Sonenberg, B.S., M.D., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.
- C. Chester Stock, B.S., M.S., Ph.D., Professor of Biochemistry, Sloan-Kettering Division.
- John Y. Sugg, B.A., M.S., Ph.D., Professor of Microbiology, Cornell University Medical College.
- Roy C. Swan, B.A., M.D., Joseph C. Hinsey Professor of Anatomy, Cornell University Medical College.

## Associate Professors

- Amir Askari, B.S., M.S., Ph.D., Associate Professor of Pharmacology, Cornell University Medical College.
- Dorothea Bennett, B.A., Ph.D., Associate Professor of Anatomy, Cornell University Medical College.
- Roy W. Bonsnes, B.S., Ph.D., Associate Professor of Biochemistry, Cornell University Medical College.
- Edward A. Boyse, M.D., Associate Professor of Biology, Sloan-Kettering Division.

## 8 FACULTY

- Dana C. Brooks, B.E.E., M.D., Associate Professor of Anatomy, Cornell University Medical College.
- Etienne de Harven, M.D., Associate Professor of Biology, Sloan-Kettering Division.
- M. Renate Dische, B.S., Ph.D., M.D., Clinical Associate Professor of Pathology, Cornell University Medical College.
- Edward R. Epp, B.A., M.A., Ph.D., Associate Professor of Biophysics, Sloan-Kettering Division.
- Betty J. Flehinger, Ph.D., Visiting Associate Professor of Biomathematics, Graduate School of Medical Sciences.
- Jørgen E. Fogh, M.D., Associate Professor of Microbiology, Sloan-Kettering Division.
- James L. German III, B.S., M.D., Clinical Associate Professor of Anatomy, Cornell University Medical College.
- Helena Gilder, B.A., M.D., Associate Professor of Biochemistry in Surgery; Assistant Professor of Biochemistry, Cornell University Medical College.
- Jack Goldstein, B.A., M.N.S., Ph.D., Associate Professor of Biochemistry, Cornell University Medical College.
- Peter J. Gomas, M.D., Ph.D., Associate Professor of Microbiology, Sloan-Kettering Division.
- Saul Green, B.S., M.S., Ph.D., Associate Professor of Biochemistry, Sloan-Kettering Division.
- Wilbur D. Hagamen, B.S., M.D., Associate Professor of Anatomy, Cornell University Medical College.
- Harold G. Hempling, B.A., M.A., Ph.D., Associate Professor of Physiology and Biophysics, Cornell University Medical College.
- Raymond W. Houde, A.B., M.D., Associate Professor of Pharmacology, Cornell University Medical College.
- Dorris J. Hutchison, B.S., M.S., Ph.D., Associate Professor of Microbiology, Sloan-Kettering Division.
- Myron S. Jacobs, B.A., M.S., Ph.D., Clinical Associate Professor of Anatomy, Cornell University Medical College.
- Kenneth G. Johnson, B.S., M.D., Associate Professor of Public Health, Cornell University Medical College.
- Richard P. Kelisky, Ph.D., Visiting Associate Professor of Biomathematics, Graduate School of Medical Sciences.
- Leonhard Korngold, B.A., M.Sc., Ph.D., Associate Professor of Microbiology, Cornell University Medical College.
- Leopold G. Koss, M.D., Associate Professor of Pathology, Sloan-Kettering Division.
- John MacLeod, B.A., M.S., Ph.D., Associate Professor of Anatomy, Cornell University Medical College.
- Robert W. McDivitt, A.B., M.D., Associate Professor of Pathology, Cornell University Medical College.
- Thomas H. Meikle, Jr., B.A., M.D., Associate Professor of Anatomy, Cornell University Medical College.
- Alice E. Moore, B.A., M.D., Associate Professor of Biology, Sloan-Kettering Division.

- Jerome S. Nisselbaum, B.A., Ph.D., Associate Professor of Biochemistry, Sloan-Kettering Division.
- Lloyd J. Old, B.A., M.D., Associate Professor of Biology, Sloan-Kettering Division.
- William M. O'Leary, B.S., M.S., Ph.D., Associate Professor of Microbiology, Cornell University Medical College.
- Aaron S. Posner, B.S., M.S., Ph.D., Associate Professor of Ultrastructural Biochemistry, Cornell University Medical College.
- Alfred M. Prince, A.B., M.A., M.D., Clinical Associate Professor of Pathology, Cornell University Medical College.
- H. Christine Reilly, B.S., Ph.D., Associate Professor of Microbiology, Sloan-Kettering Division.
- Charlotte Ressler, B.A., M.A., Ph.D., Associate Professor of Biochemistry, Cornell University Medical College.
- Leonard L. Ross, B.A., M.S., Ph.D., Associate Professor of Anatomy, Cornell University Medical College.
- Albert L. Rubin, M.D., Associate Professor of Surgery in Biochemistry, Cornell University Medical College.
- Charles A. Santos-Buch, A.B., M.D., Associate Professor of Pathology, Cornell University Medical College.
- Brij Saxena, Dr. rer. nat., Ph.D., Associate Professor of Biochemistry in Medicine, Cornell University Medical College.
- Jerome L. Schulman, B.A., M.D., Associate Professor of Public Health, Cornell University Medical College.
- Morton K. Schwartz, B.A., M.A., Ph.D., Associate Professor of Biochemistry, Sloan-Kettering Division.
- Lee A. Segel, A.B., Ph.D., Visiting Associate Professor of Biomathematics, Graduate School of Medical Sciences.
- John F. Seybolt, B.S., M.D., Clinical Associate Professor of Pathology, Cornell University Medical College.
- Julio L. Sirlin, D.Sc., Associate Professor of Anatomy, Cornell University Medical College.
- Francis M. Sirotnak, B.S., M.S., Ph.D., Associate Professor of Microbiology, Sloan-Kettering Division.
- Leslie H. Sobin, B.S., M.D., Associate Professor of Pathology, Cornell University Medical College.
- Stephen S. Sternberg, B.A., M.D., Associate Professor of Pathology, Sloan-Kettering Division.
- Leo Wade, A.B., M.D., Associate Professor of Preventive Medicine, Sloan-Kettering Division.
- Erich E. Windhager, M.D., Associate Professor of Physiology and Biophysics, Cornell University Medical College.
- Helen Q. Woodard, B.S., Ph.D., Associate Professor of Biophysics, Sloan-Kettering Division.
- Kenneth R. Woods, B.A., Ph.D., Associate Professor of Biochemistry, Cornell University Medical College.
- Ernest L. Wynder, B.A., B.S., M.D., Associate Professor of Preventive Medicine, Sloan-Kettering Division.
- Tai Te Wu, B.S., M.S., Ph.D., Associate Professor of Biomathematics, Graduate School of Medical Sciences.

## Assistant Professors

- Alberta M. Albrecht, B.A., M.S., Ph.D., Assistant Professor of Microbiology, Sloan-Kettering Division.
- Nancy W. Alcock, B.S., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- Sulamita Balagura, M.D., Ph.D., Assistant Professor of Physiology and Biophysics, Cornell University Medical College.
- William T. Beaver, M.D., Assistant Professor of Pharmacology, Cornell University Medical College.
- Carl G. Becker, B.S., M.D., Assistant Professor of Pathology, Cornell University Medical College.
- June L. Biedler, A.B., M.A., Ph.D., Assistant Professor of Biology, Sloan-Kettering Division.
- Ellen Borenfreund, B.S., M.S., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- Esther M. Breslow, B.S., M.S., Ph.D., Assistant Professor of Biochemistry, Cornell University Medical College.
- Wah-Yip Chan, B.A., Ph.D., Assistant Professor of Pharmacology, Cornell University Medical College.
- Margaret H. S. Clements, B.A., M.D., Assistant Professor of Pathology, Cornell University Medical College.
- Robert W. Dickerman, B.S., M.A., Ph.D., Assistant Professor of Microbiology, Cornell University Medical College.
- Edward S. Essner, B.S., Ph.D., Assistant Professor of Biology, Sloan-Kettering Division.
- Colin Fell, B.A., M.S., Ph.D., Assistant Professor of Physiology and Biophysics, Cornell University Medical College.
- John D. Fissekis, Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- Jerrold Fried, B.S., M.S., Ph.D., Assistant Professor of Biophysics, Sloan-Kettering Division.
- Michael D. Gershon, B.A., M.D., Assistant Professor of Anatomy, Cornell University Medical College.
- Alfredo Giner-Sorolla, M.S., Pharm. D., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- George F. Gray, Jr., B.A., M.D., Assistant Professor of Pathology, Cornell University Medical College.
- Johanna P. Hagedoorn, B.S., Ph.D., Assistant Professor of Anatomy, Cornell University Medical College.
- Mary G. Hamilton, B.A., M.S., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- Rudy H. Haschemeyer, B.A., Ph.D., Assistant Professor of Biochemistry, Cornell University Medical College.
- Arthur H. Hayes, Jr., A.B., M.A., M.D., Assistant Professor of Pharmacology, Cornell University Medical College.
- Dietrich Hoffmann, B.S., M.S., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- S. Steven Hotta, B.A., Ph.D., M.D., Assistant Professor of Biochemistry, Cornell University Medical College.

- Evelyn F. Keller, Ph.D., Assistant Professor of Biomathematics, Graduate School of Medical Sciences.
- Willi Kreis, M.D., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- John E. Lee, A.B., M.D., Clinical Assistant Professor of Anatomy, Clinical Assistant Professor of Neurology, Cornell University Medical College.
- Roberto Levi, M.D., Assistant Professor of Pharmacology, Cornell University Medical College.
- Barrie Levitt, M.D., Clinical Assistant Professor of Pharmacology, Cornell University Medical College.
- Donald W. Mackenzie, B.Sc., Ph.D., Assistant Professor of Microbiology, Cornell University Medical College.
- Theodore A. Mahowald, B.A., Ph.D., Assistant Professor of Biochemistry, Cornell University Medical College.
- C. Richard Minick, B.S., M.D., Assistant Professor of Pathology, Cornell University Medical College.
- Harold Moroson, B.S., M.S., Ph.D., Assistant Professor of Biophysics, Sloan-Kettering Division.
- Wilbur F. Noyes III, A.B., M.A., Ph.D., Assistant Professor of Biology, Sloan-Kettering Division.
- Elsa O'Donnell-Alvelda, M.S., D.Sc., Assistant Professor of Anatomy, Cornell University Medical College.
- Herbert F. Oettgen, M.D., Assistant Professor of Biology, Sloan-Kettering Division.
- Michiko Okamoto, B.S., M.D., Ph.D., Assistant Professor of Pharmacology, Cornell University Medical College.
- Elena I. R. Ottolenghi, B.A., Ph.D., M.D., Assistant Professor of Microbiology, Cornell University Medical College.
- James C. Parham II, Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- Lou Ann Pilkington, Ph.D., Assistant Professor of Physiology and Biophysics, Cornell University Medical College.
- Ira Pullman, B.S., Ch.E., M.S., Ph.D., Assistant Professor of Biophysics, Sloan-Kettering Division.
- Arthur Raines, B.S., M.D., Ph.D., Assistant Professor of Pharmacology, Cornell University Medical College.
- Barbara H. Rosenberg, B.A., M.A., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- Aubey Rotenberg, B.A., M.A., Ph.D., Assistant Professor of Biomathematics, Graduate School of Medical Sciences.
- Walter Rubin, B.S., M.D., Assistant Professor of Medicine; Assistant Professor of Anatomy, Cornell University Medical College.
- Muriel Sackler, B.A., M.S., Ph.D., Assistant Professor of Anatomy, Cornell University Medical College.
- Josephine S. Salser, B.S., M.A., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.
- Edward T. Schubert, B.S., M.S., Ph.D., Assistant Professor of Biochemistry, Cornell University Medical College.

## 12 FACULTY

Vladimir P. Skipski, M.S., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.

George Stassa, A.B., M.D., Assistant Professor of Anatomy, Cornell University Medical College.

Kurt H. Stenzel, B.A., M.D., Assistant Professor of Surgery in Biochemistry, Cornell University Medical College.

Dieter H. Sussdorf, B.A., Ph.D., Assistant Professor of Microbiology, Cornell University Medical College.

Norbert I. Swislocki, B.A., M.A., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.

Morris N. Teller, B.S., M.S., Ph.D., Assistant Professor of Biology, Sloan-Kettering Division.

Roy S. Tilbury, B.S., Ph.D., Assistant Professor of Biophysics, Sloan-Kettering Division.

Alan Van Poznak, A.B., M.D., Assistant Professor of Pharmacology, Cornell University Medical College.

Thomas E. Wagner, B.A., Ph.D., Assistant Professor of Biochemistry, Sloan-Kettering Division.

Carolyn W. Watson, B.A., M.D., Clinical Assistant Professor of Pathology, Cornell University Medical College.

Daniel Wellner, A.B., Ph.D., Assistant Professor of Biochemistry, Cornell University Medical College.

Katsuhiko Yano, M.D., Ph.D., Assistant Professor of Public Health, Cornell University Medical College.

Louis Zeitz, A.B., Ph.D., Assistant Professor of Biophysics, Sloan-Kettering Division.

# Cornell University

## GRADUATE SCHOOL OF MEDICAL SCIENCES

### PURPOSE AND NATURE OF GRADUATE STUDY

The Graduate School of Medical Sciences of Cornell University offers facilities for advanced study and research for students desiring a comprehensive view of certain areas of knowledge and training for investigation in various specific Fields. The faculty of the School requires of all candidates for advanced degrees a period of study in residence, advanced competence in some one subject, and adequate introduction to allied subjects, as well as the successful completion of stipulated language, qualifying, and final examinations.

The Graduate School of Medical Sciences offers curricula leading to the degree of Doctor of Philosophy in the Fields of Anatomy, Biochemistry, Biology, Biomathematics, Biophysics, Biostatistics, Cell Biology, Genetics, Microbiology, Neurobiology and Behavior, Pathology, Pharmacology, and Physiology, and to the Master of Science degree in certain of these Fields. Cornell University has a strong commitment to doctoral work, and the philosophy of the Graduate School of Medical Sciences is consonant with that of Cornell in this matter. The School does, however, recognize the need and place for the Master's degree in certain Fields.

The degree of Doctor of Philosophy is granted not only as a result of the fulfillment of certain technical requirements, such as residence study or satisfactory completion of graduate courses, but also as evidence of the possession and development of a critical and creative ability in science and evidence of a fruitful expression of the imagination. Proof of the latter is given in the

dissertation that the candidate prepares and which constitutes an original research contribution to the area of knowledge chosen for study.

## GRADUATE SCHOOL HISTORY

Graduate work leading to an advanced general degree has occupied a place in the Medical College since 1912 when the degree was offered in a cooperative arrangement with the Graduate School of Cornell University. Under the plan as originally announced, students registered for an advanced degree in the Medical College, but in all respects they were subject to the rules and regulations prevailing at the University. The departments offering graduate instruction were identified in the first *Announcement* as the "scientific departments."

In June, 1950, the trustees of Cornell University entered into an agreement with the Sloan-Kettering Institute for Cancer Research whereby a new division of the Medical College, namely, the Sloan-Kettering Division, was created for the purpose of offering additional opportunities for graduate study toward advanced degrees, thus extending the areas of the basic sciences. This expansion of the New York City component of the Graduate School prompted the faculty of the University's Graduate School to give consideration to matters of administration, with the result that, by action of the trustees in January, 1952, the Graduate School of Medical Sciences was established, which, with the approval of the Graduate Faculty of Cornell University, "shall have full responsibility for advanced and professional degrees granted for study in residence at the New York City campus of Cornell University."

## FACILITIES

**THE MEDICAL COLLEGE.** The buildings of the Medical College extending along York Avenue from 68th to 70th Streets contain the main library, the lecture rooms and study laboratories for the basic science departments, and the extensive research facilities for staff and students in the Fields of Anatomy, Biochemistry, Microbiology, Pathology, Pharmacology, and Physiology.

**THE SLOAN-KETTERING DIVISION.** The facilities of the Sloan-Kettering Division consist of the Howard Laboratory and the Kettering Laboratory on East 68th Street in New York City,



and the Walker Laboratory in Rye, New York. Collectively, these facilities represent the Sloan-Kettering Institute for Cancer Research. The special facilities and staff of experienced investigators of the Sloan-Kettering Division provide ample opportunities for advanced training in Biochemistry, Biology, and Biophysics.

## ORGANIZATION OF THE SCHOOL

### The Deans

The Dean of the Medical College, who holds the additional title of Associate Dean of the Graduate School of Medical Sciences, is the administrative head. He reports annually to the Graduate Faculty of Cornell University for approval of the activities of the Graduate School of Medical Sciences.

The Assistant Dean of the Graduate School of Medical Sciences aids the Associate Dean in the fulfillment of his responsibilities.

### The Faculty

The faculty includes the professors, associate professors, and assistant professors who are engaged in research and study in the Fields of biomedical sciences in which graduate study is offered and who by interest and availability of time are able to sponsor graduate students. Some instructors and research associates holding the degree of Ph.D., who are needed by a particular Field, are eligible for inclusion in the faculty and may act as representatives for minor subjects on Special Committees of graduate students.

### The General Committee of the School

The General Committee of the Graduate School of Medical Sciences is both an administrative and judicial board. The Committee considers matters referred to it by the faculty or by members of the faculty and may on its own initiative make recommendations to the faculty on any matters concerning the interests or policies of the Graduate School of Medical Sciences.

The membership of the General Committee consists of one representative from each of the Fields of graduate study. The Dean of the Medical College, who is also the Associate Dean of the Graduate School of Medical Sciences, and the Assistant Dean

are ex officio members. The faculty members of the General Committee are nominated by the Associate Dean and appointed annually by the President of the University.

The General Committee serves as an agency for: (1) Recommendations of curriculum, (2) review of requirements for degrees, (3) approval and administration of the admission of students, (4) approval of major and minor subjects, (5) allotment of units of credit toward advanced degrees, and (6) student discipline.

## ADMISSION

For admission to the Graduate School of Medical Sciences, an applicant (1) must have a baccalaureate degree or the equivalent from a college or university of recognized standing, (2) must have adequate preparation in the chosen Field of instruction, and (3) as judged by his previous record, must show promise of ability to pursue advanced study and research.

Applicants may be admitted in September, February, or July. All credentials must be submitted at least three months prior to planned admission.

Application for admission is to be made on special forms obtainable from the Office of the Graduate School of Medical Sciences, Cornell University Medical College, 1300 York Avenue, New York, N. Y. 10021. The completed application is to be returned to the School. The applicant is required to support his application for admission with two letters of recommendation from individuals in academic pursuits who know the applicant personally, and with official transcripts of record from all the colleges and universities attended by the applicant. The applicant must arrange to have the supporting credentials forwarded to the Office of the Graduate School of Medical Sciences.

Before formal application is submitted, it may be advisable for a prospective applicant to confer, either in person or by writing, with a member of the faculty in a major discipline in either the Medical College or the Sloan-Kettering Division, in order to obtain the faculty member's consent to sponsor and plan the applicant's program. In consultation with other faculty members who teach in the student's minor Fields, the sponsor organizes and acts as chairman of the faculty group, the student's Special Committee.

When application for admission is made without prior consultation with a member of the faculty, the student who is accepted will be assigned a temporary major sponsor.

Scores made in the Graduate Record Examination, although not required, will prove helpful in determining the acceptability

of the applicant. Students who plan to take this examination should communicate directly with the Educational Testing Service, Princeton, New Jersey 08540.

Proficiency tests to examine the student's background in any or all of the basic sciences presented as preparation for the Fields constituting any candidate's major and minor subjects may be required at the discretion of the candidate's major sponsor. The tests are given a few days before initial registration. Each test will cover material normally presented in undergraduate courses in those sciences. The results of these tests will be used to aid the candidate's Special Committee in planning his course of study. While the results of these tests will not be considered in the usual sense of "passing" or "failing," low marks in one or more of the tests may require a preponderance of elementary courses.

A student is admitted to the Graduate School when a formal notice of acceptance has been issued by the Associate Dean of the Graduate School of Medical Sciences. If the candidate is accepted with conditions, these will be recorded in the notice of admission.

## Provisional Candidacy

Under circumstances in which it is difficult to evaluate the academic background of qualified applicants, they may be admitted to *provisional* candidacy. Such status is often appropriate to the foreign student. Ordinarily only one semester of study in provisional candidacy is permitted, and the student who fails to qualify for candidacy at the end of that time may be requested to withdraw from the Graduate School of Medical Sciences. In any event, no more than two semesters of study in provisional candidacy are permitted, and of these no more than one may be considered as applicable to the residence requirement for a degree.

## Special Students

*All students not registered in Cornell University Graduate School and not registered for the M.D. degree are Special Students.*

Such students are *Special Students* in the true sense of the word and must be especially qualified in preparation, ability, and objective in order to receive any consideration. They may or may not be graduate students in the sense of having completed work for a collegiate degree.

Special students are admitted *only by the consent of the head of the department*, must be registered in the Administration Office of the Medical College, and must pay their fees at the Business Office before being admitted to lectures or laboratory exercises.

## Change of Status

A student who wishes to change from one degree or field to another, or who, after receiving the Master's degree, wishes to undertake candidacy for the doctorate, must submit a written request to the Office of the Graduate School of Medical Sciences asking for transfer to the new status, and giving reasons for the requested change. Provisional candidacy is automatically reviewed at the end of each semester, and no letter is necessary.

## REGISTRATION

All students must register in the office of the Graduate School of Medical Sciences at the beginning of the fall and spring semesters and the summer research period. It is expected that students who matriculate will continue for the full academic year (commencing in September and terminating with the end of the summer research period). Should circumstances require attendance for less than a year, special arrangements may be made for registering for one semester. A graduate student who has completed the residence requirements for his degree and who remains in residence while working on his thesis or while doing other work in preparation for a degree must register each semester in which he is so engaged.

A graduate student who discontinues his work during a semester in which he is registered should immediately report this fact to the Office of the Graduate School of Medical Sciences in order to obtain an official withdrawal or an honorable dismissal.

## MAJOR AND MINOR SUBJECTS

Approved major and minor subjects for the curriculum of a candidate for an advanced degree are listed below as separate Fields of instruction.

A candidate for the Ph.D. degree is required to register for one major and one or two minor subjects, as determined by the candidate's Special Committee (see below). For any Ph.D. candidate, a Field may secure permission from the General Committee of the Graduate School of Medical Sciences to require only one

minor subject. If a student in a Ph.D. program is to study a single minor subject, the third member of his Special Committee will be chosen from the faculty of the Graduate School of Medical Sciences in general.

The curriculum of a candidate for the M.S. degree consists of a major and one minor subject.

Candidates are urged to minor in a Field other than the one in which they major.

## SPECIAL COMMITTEES

Special Committees are the means for directing individual candidates in the attainment of that independence implicit in advanced degrees. A candidate's Special Committee consists of at least three members of the faculty. The candidate's major sponsor, who represents the Field of the major subject in the Special Committee, serves as the chairman. The remaining members of the Special Committee are chosen with the advice of the major sponsor from the faculty in the Fields of his major and minor subjects.

In the first year of residence, the candidate's Special Committee may be temporary and may consist only of members of the faculty in the Field of his chosen major subject. On completion of this first year, a temporary Special Committee will be replaced with a permanent committee as described above.

A candidate's permanent Special Committee may be re-formed during residence only after consultation with the major sponsor and with the approval of the Associate Dean.

Any faculty member is eligible to serve on these committees, but the chairman must be of professorial rank. An instructor may serve on a Special Committee as representative for a minor subject. When a minor subject essential to the candidate's graduate program is not represented in the Graduate School of Medical Sciences, a faculty member of another university may be selected to represent this minor subject as an *ad hoc* member of the Special Committee, on the recommendation of the major sponsor and with the approval of the Associate Dean.

The members selected indicate their willingness to serve by signing the record of major and minor subjects, which is filed with the Office of the Graduate School of Medical Sciences.

There are no regulations of the Graduate faculty on the content of instruction or courses to which the Special Committee must subscribe. The Special Committee (or the major sponsor, in the absence of an established Special Committee) is required, however, to evaluate the candidate's academic background within

a few weeks after his admission to the School and to plan on the basis of this evaluation the candidate's program for the first year of graduate study. The Special Committee may impose any requirements that it deems necessary over and above the general requirements for the School and of the Fields of the major and minor subjects.

Members of the Special Committee instruct or supervise the instruction of a candidate, judge whether the student's progress is satisfactory, conduct qualifying and final examinations, and approve the thesis. The chairman prepares reports on grades in formal courses and performance in research and makes requests for qualifying and final examinations. Although the members of the Special Committee are the candidate's advisers, it is the responsibility of the candidate himself to become familiar with the various regulations that apply to his case and to satisfy them in the proper way.

## RESIDENCE REQUIREMENTS

The faculty requires a minimum of two residence units of each candidate for a Master's degree. Candidates for a Master's degree who receive fellowships must complete all requirements for the degree within two years of initial registration. For the doctorate, a minimum of six residence units is required. One residence unit represents one academic semester of full-time study or research toward the doctoral thesis.

No residence unit or fraction is granted in fulfillment of the requirements for the Master's degree for study outside the Graduate School. In the case of a Ph.D. candidate, no commitment will be made for acceptance of previous study in another graduate school in lieu of required residence until after the candidate has entered into study in residence in the Graduate School. Then the residence units will be determined by the General Committee of the Graduate School of Medical Sciences on the basis of a transcript of record and other credentials, but may not exceed those that would be earned under similar circumstances at Cornell University; passing courses or acquiring credit hours is not regarded as evidence satisfactory in itself for transfer of credit. Under any circumstances, the residence credits transferred for graduate work in another school will be limited to a maximum of two units. Study as a candidate or as a special student in an undergraduate college is not acceptable, even though the courses may be designed for graduate students.

Graduate students who participate in teaching, or assist in research, qualify for full residence credit if their duties are in the

Field of their major subject and do not require more than twenty hours a week. Part-time graduate study, if it is necessitated by off-campus employment noncontributory to the major Field of study, is not well suited to the biomedical sciences and is not encouraged. However, if permission is granted for part-time study, the student must be in residence at least half-time, in which case the earned residence credit will be in proportion to the time in residence. An additional half unit of residence credit may be earned by registering for and satisfactorily completing an eight-week period of full-time work in summer research. The General Committee of the School will not permit anyone to receive credit for more than two units in any period of twelve consecutive months. Eligibility to receive residence units and fractions of units is determined by the General Committee of the Graduate School of Medical Sciences.

Graduate students in the Graduate School of Medical Sciences may undertake formal studies or may conduct research on the Ithaca campus. By prior arrangement, such a student registers in the Graduate School at Ithaca and works under an adviser living at Ithaca who may be appointed as an optional member of the student's Special Committee. This same privilege is available to graduate students from the Ithaca campus who find it desirable to conduct studies at the Graduate School of Medical Sciences.

A candidate for the degree of Ph.D. must complete two of the last four units in successive terms of study at the Graduate School of Medical Sciences or at the Ithaca campus, as noted above.

Each candidate for an advanced degree is expected to complete his study in residence with reasonable continuity. A candidate who fails to register during any period of four or more years is dropped from candidacy and may be readmitted only after the General Committee of the Graduate School of Medical Sciences has stipulated the amount of additional residence to be required. No more than seven years may intervene between the time of first registration and the completion of all requirements for a doctorate. A student must complete all requirements for the Master's degree in four years.

## FOREIGN LANGUAGE REQUIREMENTS

Each Field of instruction has its own foreign language requirements which it considers most useful to that particular area of study. Any Special Committee may, at its discretion, require knowledge of foreign languages beyond the requirements of the major Field of study.

The candidate may petition the Associate Dean to transfer a language examination taken and passed at another graduate school in fulfillment of requirements for an advanced degree to his record at the Graduate School of Medical Sciences.

Foreign language requirements should be completed by the end of the second year of residence. Recommendation for the awarding of a degree will be withheld until the language examinations have been passed.

The language examinations are administered by the Office of the Graduate School of Medical Sciences. It is the responsibility of the candidate to arrange for his language examinations with the Graduate School Office no later than one month prior to the dates given in the school calendar.

## EXAMINATIONS

*For the doctoral degree:* A Qualifying Examination and a Final Examination are required for the Ph.D. degree.

(1) The candidate's performance in the Qualifying Examination will enable his Special Committee to determine his fitness to continue with advanced graduate study. The Examination must be given at the end of the second semester of residence. The purpose of the Examination is to test the candidate's progress in his graduate program during the first year as well as his ability to integrate and apply the fundamental aspects of the sciences relevant to the areas of his graduate studies.

The Qualifying Examination, which may be written, oral, or both, is to be administered by the Field of the candidate's major subject in collaboration with his Special Committee. The candidate's major sponsor may select and invite any members of the faculty to assist in the administration of the Examination. The Office of the Graduate School of Medical Sciences is to be advised of the arrangements for the administration of the Examination. A report of the results of the Examination is to be submitted by the major sponsor to the Office of the Graduate School.

(2) The Final Examination must be taken in two parts: (a) Examination A, which is oral and written, covers the subject matter of the major and minor Fields. Examination A is to be given not earlier than the last month of the fourth unit of residence and at least four months before the second part, Examination B; (b) Examination B is oral and is designed to constitute a defense of the candidate's thesis. Decision that a candidate has passed or failed his Final Examination rests solely



with the members of the candidate's Special Committee; however, any member of the faculty of the Graduate School of Medical Sciences is privileged to attend the oral examinations and to take part in questioning the candidate. Members of the faculty attending the examinations are at liberty to inform the Associate Dean in writing that they disagree with the judgment of the Special Committee and may request review by the General Committee of the Graduate School of Medical Sciences of the case in question.

*For the Master's degree:* A final examination is required for the M.S. degree. This examination covers the candidate's major and minor subjects and is oral and written.

## GRADES

Graduate students taking courses in the Graduate School of Medical Sciences must register for each course and take the final examination given in that course or have the office records marked "incomplete." Courses may be audited with the permission of the department head, but no credit will be given.

Credit for graduate work is given only when the candidate does well in both his major and minor Fields of study. Professors having charge of the work of graduate students are required to report grade ratings on all students taking work under their direction to the Office of the Graduate School of Medical Sciences at the end of each semester, or at the close of each academic year. These grade reports are given in the following terms: A (93-100), B (84-92), C (75-83), and F for work unacceptable for credit. Students whose average grade falls below a B may be dropped.

## THESES

Research accomplishment presented in the form of a thesis is a principal requirement for both the M.S. and Ph.D. degrees.

Students enrolled for the Master's degree are required to prepare a report on some problem or project undertaken in their major field. In content and form this report must show scholarly attainment.

A candidate for the degree of M.S. or Ph.D. must submit an outline and early draft of the thesis to all members of the Special Committee *at least six weeks* before the Final Examination unless this requirement is modified by the Special Committee.

At least fifteen days before the Final Examination, the candidate shall submit to the Office of the Graduate School of Medical Sciences the typewritten original and one copy (carbon or other approved reproduction) of the thesis, both unbound, and two copies of an abstract of the doctoral thesis of not more than 600 words. The candidate shall also provide each member of the Special Committee with a typed copy of the thesis which the Committee members may retain until the time of the examination.

The thesis submitted to the Special Committee at least fifteen days before the Final Examination may be modified as a result of the Final Examination, but at the time of the examination, it must be complete in all respects and editorially acceptable for final approval. Subsequent to the examination, the final copies of the thesis, with the signed Thesis Approval form and copies of the endorsed abstract of a doctoral thesis, must be deposited at the Graduate School Office on or before the last day for completing requirements and not more than sixty days after the Final Examination.

Doctoral theses must show ability to do critical and independent investigation, must be a contribution to knowledge, and must be presented in a scholarly fashion. They should reflect not only mastery of a field of research, but also the ability to select an important problem for investigation and to deal with it competently. A date for the Final Examination will be set only after the chairman of the student's Special Committee gives written notice to the Office of the Graduate School of Medical Sciences that the thesis is approved.

The facilities of the University Microfilms, Ann Arbor, Michigan, are used to provide for publication of the thesis on microfilm and for the publication of the abstract of the dissertation in the monthly publication entitled *Dissertation Abstracts*.

A copy of the rules and requirements for the submission and the preparation of the thesis may be obtained from the Office of the Graduate School of Medical Sciences. The two copies of the thesis submitted to that office will be bound and deposited in the Medical College Library and in the department where the thesis work was done.

## EXPENSES

The fee for the Graduate School of Medical Sciences for the academic year is \$1,800. This is an inclusive fee with \$1,514 of the amount apportioned for tuition and the remainder for all

accessory items: matriculation, student hospitalization insurance, laboratory charges, graduation fee, microfilming of the doctoral thesis, publishing the abstract in the monthly periodical, *Dissertation Abstracts*, mailing the thesis and abstract to and from the microfilm publishers, and binding two copies of the thesis.

Graduate students who have completed the minimum residence requirements and have paid the tuition fees for their degrees may complete their theses in residence. No additional tuition payment will be required, but a registration fee of \$286 per academic year will be charged to cover hospitalization insurance, etc.

Fees may be paid in three equal parts, the first of which must be payable at registration.

A graduate student who returns to the Graduate School of Medical Sciences to present his thesis and take the Final Examination for an advanced degree (all other work for that degree having been previously completed) must register as a "Candidate for Degree Only" and pay at that time a fee of \$35.00.

*Tuition or other fees may be changed by the Board of Trustees at any time without previous notice.*

## FINANCIAL ASSISTANCE

Predoctoral fellowships are available to qualified applicants. The fellowships may be renewed yearly providing the academic performance of the fellowship holders is satisfactory. Teaching and research assistantships are available to qualified graduate students in some departments of the Medical College. In addition to a stipend, the costs of tuition and other fees are defrayed for those students receiving financial assistance.

The applicant may obtain information on the available fellowships and assistantships by writing directly to the chairman of the department of his proposed major field, Cornell University Medical College, 1300 York Avenue, New York, N. Y. 10021, or to the Associate Director of the Sloan-Kettering Division, 425 East 68th Street, New York, N.Y. 10021.

Other predoctoral fellowships are available on a national basis from the National Science Foundation, the National Research Council, and the National Institutes of Health. Information on these fellowships should be requested directly from the appropriate government agency. The Graduate School of Medical Sciences will provide the granting agency with the necessary credentials to support the fellowship application of applicants who qualify for admission to the School.

New York State grants every resident who applies and who is certified to be a full-time student a Scholar Incentive Award

which may be for graduate students, from \$100 to \$300 per term in the first year, and from \$200 to \$400 per term thereafter, depending on required tuition and income. Application forms for the Scholar Incentive Award may be obtained by writing directly to the Regents Examination and Scholarship Center, State Education Department, Albany, N.Y. 12224.

## STUDENT HEALTH SERVICE

Complete ambulatory medical care is provided for all students matriculated in the Graduate School of Medical Sciences through the Personnel Health Service of the Medical Center. Students matriculating for the first time in the Graduate School are required to have a physical examination by a member of the Health Service staff. In addition each student must report for a chest x ray examination, tuberculin test, and such immunizations as may be considered necessary at periodic intervals. No charge is made for medical care through the Health Service nor for any x rays, laboratory tests, or procedures which may be needed. Each student is required to carry Associated Hospital Service (Blue Cross) hospitalization insurance unless some similar hospitalization insurance is currently in effect through a previous policy. The cost of this insurance for an unmarried student is included in the fee discussed in the section "Expenses." Wives and dependents of students may be covered by the hospitalization insurance policy for a small additional fee. Office hours are held Monday through Friday from 12:30 to 1:30 p.m. by the Student Health staff. All cases of illness must be reported to the Health Service. Students may have in attendance physicians of their own choice, but a reasonable amount of cooperation between such physicians and the College Health Service is expected. Wives and families of students are not eligible for care through the Personnel Health Service but will be referred to appropriate members of the hospital staff for medical care.

## SUMMARY OF REGULATIONS FOR GRADUATE STUDENTS

A student contemplating admission to graduate work leading to the M.S. or Ph.D. degree must first obtain approval of his program from a member of the faculty. If encouraged by the faculty member to proceed, the student may file his application.

When registered for one of these degrees, the candidate should observe carefully the following requirements:

## For the Master's Degree

He must—

1. Complete a minimum of two units of work in residence, including a major and one minor course of study.
2. Demonstrate proficiency in one foreign language.
3. Pass a final examination covering his general Field of study.
4. Present a thesis approved by the professor representing his major Field of study and the General Committee of the Graduate School of Medical Sciences.
5. Submit two typewritten copies of the thesis, one for filing in the Medical College Library and the other for the department representing his major Field of study.

## For the Ph.D. Degree

He must—

1. Complete six units of training in residence, of which two units of the last four must be taken in successive terms at the Medical College or the Sloan-Kettering Division.
2. Demonstrate proficiency in the foreign languages specified by the major Field of study and/or by his Special Committee.
3. Achieve a high level of scholarly capacity (grade of B or better) and demonstrate the ability and technique necessary for carrying on original work.
4. Complete the following examinations: (1) a Qualifying Examination at the end of the second semester of residence, and (2) the Final Examination (Parts A and B).
5. Present a thesis in the major Field of study, which must represent a contribution to the subject investigated.
6. Prepare an abstract of the approved thesis for publication in *Dissertation Abstracts*.
7. Submit two unbound typewritten copies of the thesis at least fifteen days before Examination B, one for filing in the Medical College Library and the other for the department representing the major Field of study.

## RESEARCH SOCIETIES

Sigma Xi, a national honorary society devoted to the encouragement of scientific research, was founded at Cornell University at Ithaca in 1886. An active branch of the Cornell Chapter is maintained at the Medical College. Graduate students are eligible

for election to membership in Sigma Xi on the basis of proved ability to carry on original research and on nomination by active members of the Cornell Chapter. Graduate students elected to the society prior to enrolling at Cornell are invited to become active members of the local chapter.

The Cornell University Medical Research Society will hold meetings weekly on Tuesdays, throughout the academic year. This informal society offers faculty members of all divisions of The New York Hospital-Cornell Medical Center an opportunity to present papers dealing with original research. Graduate students are invited to attend the meetings and to submit papers for possible presentation.

## FIELDS OF INSTRUCTION

The several Fields of instruction of the Graduate School of Medical Sciences are described in the pages that follow. The title of each Field is an approved major or minor subject for candidates for advanced degrees. In addition to these Fields, advanced degree programs are available in certain Fields not separately described. They are: Biostatistics, Cell Biology, Genetics, and Neurobiology and Behavior. Information regarding graduate study in any one of the latter Fields may be obtained through the Office of the Graduate School of Medical Sciences.

## INSTRUCTION AT THE MEDICAL COLLEGE

### Anatomy

Chairman: Professor Roy C. Swan.

Professor: Roy C. Swan.

Associate Professors: Dorothea Bennett, Dana C. Brooks, James L. German III, Wilbur D. Hagamen, Myron S. Jacobs, John MacLeod, Thomas H. Meikle, Jr., Leonard L. Ross, Julio L. Sirlin.

Assistant Professors: Michael D. Gershon, Johanna Hagedoorn, John E. Lee, Elsa O'Donnell-Alvelda, Walter Rubin, Muriel Sackler, George Stassa.

Instructors: Irene Geyer-Duszynska, John C. Weber.

Graduate study in Anatomy leads to the Ph.D. degree and emphasizes the basic relationships between structure and function of biological systems at all levels of organization. Through individually-planned programs of formal coursework, independent study, seminars, and supervised individual research, candidates are prepared for a research and teaching career in the various areas of the broad field of anatomy. Specific courses, taught in the medical curriculum, are offered in genetics, developmental anatomy, human gross anatomy, microscopic anatomy, and neuroanatomy. Opportunities for particular specialization in research training in anatomy include: histology, cytology, electron microscopy, neuroanatomy, human male fertility, embryology, and genetics.

Adequate undergraduate preparation for graduate study in anatomy should provide proficiency in biology, chemistry, physics, and mathematics. A reading knowledge of French or German is suggested although there is no specific language requirement. Applicants are generally advised to present the results of the Graduate Record Examination. In selecting students for graduate study in anatomy, emphasis is placed on quality of performance and promise for a productive scientific

career. Requirements for admission are flexible in proportion to the promise and accomplishments of the applicant. Specific requirements for minor sponsorship in the Field of Anatomy are also flexible, but research experience in the minor sponsor's laboratory is strongly encouraged.

## COURSES OFFERED

1. **GENETICS SEMINAR.** Organized on the basis of four semesters in sequence: nucleic acids and genetic fine structure; cytogenetics; differentiation and gene action in higher organisms; genetics of man and medical genetics. Prerequisites: six hours of undergraduate genetics and permission of the instructors.

2. **ANATOMY SEMINAR.** Two seminars each month are scheduled on selected topics in the broad subject of anatomy including fine structure, development, cell biology, neuroanatomy, and genetics. Senior members of the anatomy staff and guest speakers will conduct informal discussions on current research in their respective fields.

## Biochemistry

Chairman: Professor Alton Meister.

Professors: Alton Meister, Julian R. Rachele.

Associate Professors: Roy W. Bonsnes, Jack Goldstein, Aaron S. Posner, Charlotte Ressler, Albert L. Rubin, Kenneth R. Woods.

Assistant Professors: Esther M. Breslow, Helena Gilder, Rudy H. Haschemeyer, S. Steven Hotta, Theodore A. Mahowald, Edward T. Schubert, Kurt H. Stenzel, Daniel Wellner.

Instructors: Suresh S. Tate, John D. Termine.

Graduate instruction is offered leading to the Ph.D. or Master's degree. Within the framework of degree requirements and in consultation with the student, the course of study is planned to fit the needs of the individual. Although formal course work is required, emphasis is placed on research. Research opportunities exist in various areas of biochemistry including enzymology, structure and function of proteins and nucleic acids, molecular biology, physical biochemistry, and the intermediary metabolism of amino acids, carbohydrates, nucleic acids, and lipids. Entering graduate students usually work for short periods in several of the laboratories in the Department of Biochemistry before beginning thesis research. Students are encouraged to choose challenging and fundamental research problems that are on the frontiers of biochemistry.

The Department is equipped with virtually all of the instruments and facilities required for modern biochemical research; thus, graduate students are instructed in such methodology as chromatography, counter-current distribution, radioactive and stable isotope techniques.



spectrophotometry, electrophoresis, and analytical ultracentrifugation.

Students undertaking graduate study in biochemistry must have a sufficiently comprehensive background in chemistry to pursue the proposed course of study and must present evidence of knowledge of biology, general experimental physics, and mathematics (including differential and integral calculus). Opportunity is offered to remedy deficiencies in these areas during the first year of graduate study. The Graduate Record Examination (the aptitude test and the advanced test in chemistry) is ordinarily required.

## COURSES OFFERED

1. **GENERAL BIOCHEMISTRY.** This introductory course is designed to provide the student with a knowledge of the fundamentals of biochemistry and an appreciation of the molecular basis of biological phenomena. Instruction includes lectures, demonstrations, assigned readings, reports, and laboratory work on proteins, nucleic acids, enzymes, carbohydrates, fats, vitamins, hormones, and other compounds of biological importance. Consideration is given to metabolism, genetics, nutrition, and to the application of biochemical and biophysical principles to biological phenomena. First trimester, 12 Noon–1 P.M.; 2–3 P.M. on Monday, and 12 Noon–1 P.M. on Tuesday, Wednesday, Thursday, and Friday. Third trimester, hours to be arranged.

Graduate students in Biochemistry are required to pass this course (or its equivalent) prior to pursuing advanced courses.

2. **TOPICS IN ADVANCED BIOCHEMISTRY.** Lectures and conferences in the Department on recent developments in biochemistry. Hours to be arranged.

3. **BIOCHEMICAL PREPARATIONS AND TECHNIQUES.** Laboratory work dealing with the isolation, synthesis, and analysis of substances of biochemical importance (enzymes, coenzymes, various metabolites, and intermediates), and study of their properties by chemical and physical techniques. Hours to be arranged.

4. **ADVANCED GRADUATE BIOCHEMISTRY.** The course and the hours when it is given are described in the section "Interdepartmental Courses."

## Biomathematics

Please refer to page 39 for complete listing of faculty, description of program, and courses.

## Biostatistics

Please refer to page 40 for complete listing of faculty, description of program, and courses.

## Cell Biology

Cell Biology is concerned fundamentally with the nature of cells, involving study of the molecular basis of cellular architecture, the biochemical basis of cellular activity, and of the mechanisms involved in the organization of cellular activity and behavior. The techniques of cell biology thus include cell culture, both light and electron microscopy, isolation of cellular sub-fractions, enzymology, genetical and biochemical analysis. Such technics are used to gain insight into the alterations of cell structure and function that accompany differentiation, disease, and the initiation and control of growth processes in normal cells, as well as their modification in neoplasia.

Inquiry regarding graduate study in the Field of Cell Biology should be addressed to the Assistant Dean of the Graduate School of Medical Sciences.

## Genetics

The Field of Genetics offers an integrated program designed to train geneticists of broad scope and biological background, with specialization in several different areas including cytogenetics, human biochemical and cell genetics, mammalian developmental genetics, microbial genetics, nucleic acid chemistry and biochemistry, and virology.

Inquiry regarding graduate study in the Field of Genetics should be addressed to the Assistant Dean of the Graduate School of Medical Sciences.

## Microbiology

Chairman: Professor William F. Scherer.

Professors: William F. Scherer, John Y. Sugg.

Associate Professors: Leonhard Korngold, William M. O'Leary.

Assistant Professors: Robert W. Dickerman, Donald W. Mackenzie, Elena I. Ottolenghi, Dieter H. Sussdorf.

Candidates for the Ph.D. degree and postdoctoral fellows can select an area of research interest and activity from such microbiological topics as general and medical bacteriology, microbial chemistry and physiology, microbial genetics, immunology, mycology, and virology.

Prospective students should complete at the undergraduate level a minimum of one year (or its equivalent) in general chemistry, organic chemistry, general physics, mathematics including college algebra, botany or zoology (preferably both), and one semester or its equivalent of analytical or quantitative chemistry. General microbiology or bacteriology and calculus are strongly recommended. Students who have not completed the above requirements may be admitted to graduate

study on the condition that deficiencies be removed soon after admission.

Courses in graduate work are determined by the student's Special Committee made up of faculty members representing his major and minor subjects. Included for Ph.D. candidates in Microbiology are the following courses: medical microbiology, microbial chemistry and physiology, advanced immunology, advanced virology, microbial genetics, microbiology seminar, biochemistry, and biostatistics.

The nature and number of other courses depend on the student's minor subjects, his research activities, his individual interests, and the advice of his Special Committee. Such courses at this institution or at near-by universities are available in anatomy, biophysics, cell biology, histology, mycology, parasitology, pathology, pharmacology, physiology, and radiobiology.

Degree requirements include two minors and two languages.

## COURSES OFFERED

Graduate courses are given during the eleven-week period corresponding to the third trimester of the Medical College curriculum. Lectures are open to all interested persons. Laboratory sessions are generally limited to students taking the course for credit.

1. MICROBIAL CHEMISTRY AND PHYSIOLOGY. Yearly. Two lectures and two laboratory periods weekly. Lectures cover literature and methodology pertinent to physicochemical properties of microorganisms and their environments, the growth and death of microorganisms, chemical composition of cells and subcellular structures, nutritional requirements, microbiological assay and auxotrophic mutants, energy metabolism, degradations and biosyntheses, the physiology of pathogenesis, and important microbial products. Laboratory sessions provide experience with large-scale culture and recovery of cells, synthetic media, microbiological assay, extraction of cellular constituents, respirometry, and studies of substrate utilization employing radioactive metabolites. Minimum prerequisites for credit are general microbiology, qualitative and quantitative analysis, organic chemistry, and at least one semester (or its equivalent) of biochemistry.

2. ADVANCED IMMUNOLOGY. Every second or third year. Two lectures and two laboratory periods weekly. Lectures emphasize current concepts regarding antigen and antibody structure, the physical and biological manifestations of antigen-antibody reactions, and recent developments in studies on the cellular basis of immunity, including antibody formation. The laboratory will cover the isolation, purification, and quantification of antibodies; the critical measurement of antigen-antibody reactions; histological mechanisms during the immune process; and *in vivo* effects of specific antigen-antibody reactions. Minimum prerequisites for credit are introductory immunology (as given in courses in general microbiology) and at least one semester (or its equivalent) of biochemistry. A semester course in histology or microscopic anatomy is desirable.

3. **ADVANCED VIROLOGY.** Every second or third year. This course presents, in lectures and laboratory sessions, modern concepts and techniques of virology. Virus structure, chemical composition, physical and biologic properties, and relationships with host cells are considered in depth. Minimum prerequisites for credit are general microbiology and at least one semester (or its equivalent) of biochemistry.

4. **MICROBIAL GENETICS.** Every second or third year. Two lectures and two laboratory sessions weekly. The lectures deal with genetic systems in fungi, bacteria, and bacterial viruses. Emphasis is placed on those basic concepts of genetics which have been elucidated by the study of microbial systems. Laboratory experiments are designed to demonstrate some of the mechanisms of genetic recombination among microorganisms. Minimum prerequisites for credit are general microbiology and at least one semester (or its equivalent) of biochemistry. A course in general genetics is desirable but not required.

5. **MICROBIOLOGY SEMINAR.** Scheduled biweekly. Topics in microbiology and infectious diseases are presented in depth by faculty and graduate students of the Department of Microbiology and by visiting scientists from other institutions.

## Neurobiology and Behavior

Seminars, courses and supervised research experience in the Field of Neurobiology and Behavior are designed to present an integrated, multidisciplinary approach to graduate training in the neurological and behavioral sciences. Within this broad interdepartmental field, specific areas of available research concentration include: neuroanatomy, neurochemistry, neuropharmacology, neurophysiology, and neuropsychology and perception.

During his first year of graduate study prior to the selection of his Special Committee, each student's program of coursework and introductory research experience is supervised by staff members from other fields with specific interest in neurobiology and behavior. This period permits students to familiarize themselves with specific research areas and problems before selecting an area of major concentration. An individualized program of graduate study is then developed for each student by his Special Committee.

Although requirements for admission to this field are necessarily flexible, applicants should have had undergraduate coursework in depth in biology, chemistry or psychology; physics and mathematics are strongly recommended. Applicants are normally requested to present the results of the Graduate Record Examination.

Inquiry for additional information regarding graduate study in the Field of Neurobiology and Behavior should be addressed to the Assistant Dean of the Graduate School of Medical Sciences.

## Pathology

Chairman: Professor John T. Ellis.

Professors: A. Whitley Branwood, John T. Ellis, Milton Helpern, Aaron Kellner, John G. Kidd, Robert C. Mellors, George E. Murphy.

Associate Professors: M. Renate Dische, Robert W. McDivitt, Alfred M. Prince, Charles A. Santos-Buch, John E. Seybolt, Leslie H. Sobin.

Assistant Professors: Carl G. Becker\*, Margaret H. S. Clements, George F. Gray, C. Richard Minick, Carolyn W. Watson.

Instructors: Daniel R. Alonso, Janet A. Mouradian, L. David Stacey, Jr.

The Department of Pathology offers a wide opportunity for the experimental study of disease. Adequate animal facilities are available. Most of the current journals and reference books are kept in the departmental library. Autopsies for the entire hospital are performed by members of the Department, and this material, together with specimens in the laboratories of surgical pathology and cytology, offers opportunities for the study of many problems of disease.

Study at the graduate level is oriented toward scientific training in experimental pathology, and special emphasis is placed on basic training in the fundamental aspects of pathology. By contact with individual staff members, instruction and training is given in immunopathology; neuropathology; basic cellular pathology including electron microscopy, cyto- and histochemistry, cell fractionation and biochemical and biophysical methods; fundamental experimentation with laboratory animals in the study of disease; and gross and microscopic pathology of human tissues and organs.

Candidates will be required, as an initial part of their program, to take the second-year course offered to medical students. The latter part of the graduate's training will be devoted to research in an area of the candidate's choice under the guidance of a senior staff member.

A candidate can qualify for the Ph.D. degree by majoring in Experimental Pathology. Graduates who do not possess the M.D. degree must have an adequate knowledge of biology, chemistry, mathematics, and physics. The necessary preparation in anatomy, biochemistry, physiology, and biometrics may be obtained at the Medical College as part of the graduate program.

## COURSES OFFERED

1. GENERAL AND SYSTEMATIC PATHOLOGY. Lectures, practical classes and seminars. First and second trimesters.

2. CORRELATIVE PATHOLOGY. Gross and microscopic material is correlated and related to the disease processes. This course given daily embraces supervised work on the autopsy service, surgical pathology and cytology services.

\* On leave of absence.

3. **FORENSIC PATHOLOGY.** Courses are offered in the above, working by special arrangement primarily in the office of the Chief Medical Examiner of the City of New York.

4. **SEMINARS IN PATHOLOGY.** Discussions, outlining the scope of modern pathology are given weekly. These include reports on original research by members of staff and by visiting lecturers together with discussions on problems in pathology.

5. **EXPERIMENTAL PATHOLOGY.** Independent research projects in various fields of pathology can be offered.

## Pharmacology

Chairman: Professor Walter F. Riker, Jr.

Professors: Walter Modell, Walter F. Riker, Jr.

Associate Professors: Amir Askari, Raymond Houde.

Assistant Professors: William T. Beaver, Wah-Yip Chan, Arthur Hayes, Roberto Levi, Barrie Levitt, Michiko Okamoto, Arthur Raines, Alan Van Poznak.

Facilities are available for advanced work and research in the chemical, pharmacodynamic, and clinical aspects of pharmacology. Special opportunities are afforded for work in general pharmacology, neuropharmacology, cardiovascular pharmacology, biochemical pharmacology, and drug evaluation in man. The Department of Pharmacology is well equipped with specialized apparatus for electrophysiological and biochemical techniques.

In graduate training, emphasis is placed on sound basic training in general pharmacology. By means of individual instruction, the candidate is later afforded an exposure to several specialized aspects of pharmacology. The latter part of the graduate curriculum is devoted to research in an area of the candidate's choice.

An adequate preliminary training in organic chemistry, physical chemistry, biochemistry, and physiology is prerequisite to graduate work in pharmacology. Training in statistics is strongly recommended.

Proficiency in one foreign language is required of all Ph.D. candidates majoring in Pharmacology.

## COURSES OFFERED

1. **GENERAL PHARMACOLOGY.** The basic pharmacology course as offered to second-year medical students is open to graduate students. The course consists of lectures, laboratory work, demonstrations, and seminars given during the first and second trimesters. The purpose of these exercises is to teach the principles of pharmacology. Detailed consideration is given to the parameters of drug action so as to provide the student with the fundamental concepts essential for the evaluation of any drug. Consequently, emphasis is placed on the scientific basis of

pharmacology. Prototype drugs, considered essentially systemically, serve to illustrate several mechanisms and parameters of drug action. Therapeutic applications are considered only insofar as they illustrate principles of pharmacology or drug hazards. 154 hours. Prerequisites: biochemistry and physiology.

2. SPECIAL TOPICS IN BIOCHEMICAL PHARMACOLOGY. Offered in the first semester. In a series of two weekly lectures of one hour each the following topics will be presented: (a) mechanisms of biotransformation of drugs, and the relevance of drug metabolism to pharmacologic actions of drugs; (b) modifications of cell metabolism by certain drugs, and the relations of these modifications to the mechanisms of actions of these drugs.

3. PHYSIOLOGY AND PHARMACOLOGY OF JUNCTIONAL TRANSMISSION. Offered in the second semester. In a series of two weekly sessions of one hour each consideration will be given to the following: (a) current concepts of junctional transmission; (b) influence of certain drugs on junctional transmission; (c) the significance of pharmacologic analysis for revision of current concepts of junctional transmission; (d) the role of the motor nerve terminal in the physiology and pharmacology of junctional transmission; (e) trophic influences of nerve.

4. ADVANCED CARDIOVASCULAR PHARMACOLOGY. Offered in the second semester. In a series of two weekly sessions of one hour each the following areas will be explored: (a) the actions of cardiac glycosides on normal and abnormal cardiac tissue; (b) the pharmacologic responsiveness of the neural innervation of the heart; (c) the genesis of various dysrhythmias and the mechanisms of action of antiarrhythmic agents; (d) the role of endogenous catecholamines in cardiovascular function and the effect of adrenergic blocking substances; (e) the basis for the pharmacologic regulation of blood pressure; (f) the pharmacologic approach to shock and its special problems.

5. SEMINAR IN PHARMACOLOGY. A lecture-seminar course with students actively participating in the presentation and discussion of the seminar. The course is required for all graduate students majoring in Pharmacology, and is open to other interested students. The course will consist of several series of seminars each with a central theme on one of the basic principles of pharmacology. A staff member will provide an introductory lecture to each series. Reading materials are then assigned for seminar presentation and critical evaluation by the students. Two-hour session every other week throughout the school term.

6. RESEARCH IN PHARMACOLOGY. Research opportunities may be arranged throughout the year for graduate students who are not majoring in pharmacology but who wish some investigative experience in the discipline. Special opportunities are offered for work on the nervous and cardiovascular systems and in biochemical aspects of pharmacology.

## Physiology and Biophysics

Chairman: Professor Robert F. Pitts.

Professors: Roger L. Greif, Robert F. Pitts.

Associate Professors: Harold G. Hempling, Erich E. Windhager.

Assistant Professors: Sulamita Balagura, Colin Fell, Lou Ann Pilkington.

Opportunities are offered for graduate study toward a Ph.D. degree and for postdoctoral research training in limited areas of Physiology and Biophysics, including the physiology of the circulatory system, endocrine organs, and kidney, and the biophysics of membrane transport. The laboratory is well equipped for both chemical and physical studies on living animals. The staff has special competence in areas of acid-base regulation; the renal tubular transport of ions employing micropuncture techniques; the transport of ions, water, and organic metabolites in uniform cell populations; the mode of action of thyroid hormones; the metabolism of the kidney; and the distribution of blood flow to organs in circulatory shock. Postdoctoral fellows are accepted for one or two years of closely supervised research experience under the direction of a member of the staff. A few selected graduate students are prepared for a career in teaching and research in physiology and biophysics through recommended coursework, participation in seminars, and closely supervised research leading toward the preparation of a satisfactory thesis. Adequate training in chemistry, physics, mathematics, and biology is prerequisite to graduate study. Graduate students with majors in other departments may elect physiology as a minor providing they have obtained adequate background in general mammalian anatomy, neuroanatomy, and histology.

### COURSE OFFERED

1. TOPICS IN BIOPHYSICS. Offered in the second trimester. In a series of weekly sessions of one to two hours, several areas in which concepts derived from chemistry and physics have influenced biological thought will be reviewed and analyzed. The choice of topics will depend, in part, on the interests of the students. Previous topics have included: membrane physiology and biophysics, biological reaction rates, topics in irreversible thermodynamics. Where appropriate, demonstrations or laboratory exercises will be included. Prerequisites: physics, physical chemistry, differential and integral calculus.

## Public Health (Microbiology, Epidemiology, and Virology)

Chairman: Professor Walsh McDermott.

Professors: Edwin D. Kilbourne, Walsh McDermott.

Associate Professors: Kenneth G. Johnson, Jerome L. Schulman.

Assistant Professor: Katsuhiko Yano.



In this Department of the Medical College a graduate degree (Ph.D.) may be obtained in certain of the medical sciences related to public health. Microbiology, with particular emphasis on virology and mycobacterial infections, is a field of special interest in the Department. Advanced training and research are conducted in these areas and include studies of influenza virus genetics, experimental (viral) epidemiology, host determinants of viral virulence, and experimental chemotherapy. Studies and research in human epidemiology are also conducted in the Department. No formal courses of instruction are offered, but informal staff seminars in virology are held weekly. The University does not grant a Master's degree or a doctorate in public health.

Courses available to graduate students. No formal course work.

## DIVISION OF BIOMATHEMATICS

The Field of Biomathematics is supported jointly by the Medical College and the Sloan-Kettering Division.

### Biomathematics

Professor: Sol I. Rubinow.

Visiting Professors: Hirsh G. Cohen, Joel L. Lebowitz.

Associate Professor: Tai Te Wu.

Visiting Associate Professors: Richard P. Kelisky, Lee A. Segel.

Assistant Professors: Evelyn F. Keller, Aubey Rotenberg.

The Division of Biomathematics offers a wide range of opportunities for the development of quantitative methods in the biological and medical sciences, with special emphasis on the application of mathematics. Graduate study programs leading to advanced degrees in the Field of Biomathematics are available to students whose primary interests are mathematical, but who wish to concentrate on biological or medical applications.

Graduate students in the Field of Biomathematics are required to obtain thorough training in linear algebra, complex variables, and partial differential equations and boundary value problems. In addition to other courses, an appropriate plan of study in the relevant aspects of biology, chemistry, physics, and medicine will be made to suit the particular area of application of the individual student. Some typical research areas in Biomathematics are cell and chemical kinetics, biophysics, molecular biology, and physiological systems.

Special opportunities are also available for research at the postdoctoral level. Although postdoctoral fellows should have a high degree of competence in the basic skills of biomathematics, they need not necessarily be professional mathematicians.

## COURSES OFFERED

1. **INTRODUCTORY BIOMATHEMATICS I and II.** An introduction to the use of elementary mathematics in various areas of medicine and biology. Topics vary from year to year. The mathematical topics to be covered are the following: linear algebra, matrices, ordinary and partial differential equations, and difference equations. Applications will be made to vision, chemical and cell kinetics, tracer studies, population dynamics, membranes, sedimentation, diffusion, and biological clocks. Prerequisite: elementary calculus.

2. **BIOMATHEMATICS SEMINAR.** Presentation of research investigations by the staff, as well as student reports on various topics chosen from the current literature. Required of Biomathematics majors.

## Biostatistics

Visiting Professor: Joel L. Lebowitz.

Visiting Associate Professors: Betty J. Flehinger, Richard P. Kelisky.

Research Fellows: Daniel A. Bloch, Valerie Miké.

Graduate study programs leading to advanced degrees in the Field of Biostatistics are available to students whose primary interests are statistical, but who wish to apply their knowledge to biological and medical problems.

Students in the Field of Statistics are required to obtain thorough training in probability theory and fundamentals of statistical inference. They are expected to become expert in the utilization of automatic computers in conjunction with their research. A programming language such as Fortran is required in lieu of a foreign language. Some typical research areas in Biostatistics are differential diagnosis, planning of clinical trials, storage and retrieval of medical information, and surveillance programs.

Special opportunities are available for research at the postdoctoral levels primarily for statisticians who wish to apply themselves to problems arising in biology and medicine.

## COURSES OFFERED

1. **INTRODUCTION TO PROBABILITY AND STATISTICS I and II.** The aim of this course is to help graduate students in the life sciences gain some insight into the theory underlying a probabilistic approach to the treatment of observational or experimental data, and to acquaint them with the major techniques of statistical analysis. Part I will cover the basic concepts of probability theory. Part II will deal with an elementary formulation of the principles of statistical inference. All the material presented will be illustrated extensively by examples from biology and the medical sciences. There are no prerequisites.

2. **STATISTICAL INFERENCE AND DECISIONS IN MEDICINE.** A survey of statistical methods useful in planning medical experiments and drawing conclusions from observed data.

3. **BIostatistics SEMINAR.** Reports and discussion by the staff and other investigators on statistical methods utilized in the collection, analysis, and interpretation of biological data. Required of biostatistics majors.

## INTERDEPARTMENTAL COURSES

**ADVANCED GRADUATE BIOCHEMISTRY.** A graduate course in biochemistry is offered jointly by the faculties of the Sloan-Kettering Division and the Medical College over a two-year period. In each trimester, eleven two-hour lectures are given once a week. It is not essential that students take the course in any particular sequence. The course includes consideration at an advanced level of the following subjects, with particular attention to contributions of recent research: 1968-69 Trimester 1: enzymology; Trimester 2: carbohydrates, lipids and hormones; Trimester 3: physical methods in biochemistry. 1969-70 Trimester 1: chemistry of proteins; Trimester 2: chemistry of nucleic acids; Trimester 3: physical methods in biochemistry.

**GENERAL MICROBIOLOGY.** This course is offered by the personnel of the Field of Microbiology at the Medical College and the Sloan-Kettering Division. It is intended to provide a wide-ranging general knowledge of the subject for students minoring in microbiology and for non-minors who want a background in the subject. It is not primarily intended for students majoring in the subject who already have an extensive background from undergraduate school. Two hour-lectures are given weekly during both semesters. Aspects of microbiology covered include fundamental procedures, microbial growth and physiology, genetics, immunology and serology, virology, plant and animal pathogens, and applied microbiology. Auditors from all fields and divisions are welcome.

**GENETICS SEMINAR.** An advanced seminar in genetics is offered each semester by the faculties of the Medical College and the Sloan-Kettering Division. The seminar consists of one weekly two-hour session with the following schedule:

Fall semester, 1968: Microbial and Molecular Genetics

Spring semester, 1969: Cellular Genetics

Fall semester, 1969: Regulation and Control Mechanisms

Spring semester, 1970: General (Classical) Genetics

Fall semester, 1970: Gene Action and Differentiation in Higher Organisms

Spring semester, 1971: Human Genetics and Medical Genetics

Six or more university-credit hours in genetics, or attendance at the lectures pertaining to genetics given in the Department of Anatomy, and the instructor's permission are required for admission. Two semesters are required for a minor in Genetics, and four semesters are required for a major in Genetics.

## INSTRUCTION AT THE SLOAN-KETTERING DIVISION

Frank L. Horsfall, Jr., Director  
Liebe F. Cavalieri, Associate Director

**GRADUATE SEMINAR.** The weekly graduate seminar is offered each year and is attended by all graduate students of the Division. The subjects covered vary from year to year, but in general they deal with problems of modern biology. Two or three topics are selected for discussion each year, and an attempt is made to rotate the subjects on a three-year cycle. Topics are usually chosen from the following: nucleic acid and protein chemistry and biochemistry; chromosome structure and function; special topics in bacterial genetics; regulation; radiobiology; mammalian and bacterial viruses. The discussion is carried principally by graduate students under the guidance of faculty members whose area of specialization coincides with the topic. From time to time outstanding authorities on the subject are invited as guest speakers.

### Biochemistry

Chairman: Professor Mary L. Petermann.

Professors: M. Earl Balis, Aaron Bendich, Oscar Bodansky, George B. Brown, Liebe F. Cavalieri, Jack J. Fox, Mary L. Petermann, Martin Sonenberg, C. Chester Stock.

Associate Professors: Saul Green, Jerome S. Nisselbaum, Morton K. Schwartz.

Assistant Professors: Nancy W. Alcock, Ellen Borenfreund, John D. Fisekakis, Alfredo Giner-Sorolla, Mary G. Hamilton, Dietrich Hoffmann, Willi Kreis, James C. Parham II, Barbara H. Rosenberg, Josephine S. Salser, Vladimir P. Skipski, Norbert I. Swislocki, Thomas E. Wagner.

Instructors: Martin Fleisher, Edward D. Lash.

Opportunities are available for advanced work and research in chemistry and metabolism, bio-organic chemistry, enzymology, hormone chemistry and action, and molecular biology.

Undergraduate requirements for a major in Biochemistry include courses in inorganic chemistry, qualitative chemistry, quantitative chemistry, organic chemistry, physical chemistry, physics (mechanics; electricity and magnetism; and sound, heat, and light), biochemistry, and mathematics (through calculus). If any of these requirements are not completed at the undergraduate level, they must be completed at the onset of graduate study. Furthermore, although the Graduate Record Examination is not generally required of applicants, those applicants who are not within the top third of their graduating class are urged strongly to support their applications with scores attained on the Graduate Record Examination in both the aptitude test (verbal and quantitative) and the advanced test in chemistry.

Students electing Biochemistry as a major or minor subject must complete the Medical College course in biochemistry, or its equivalent, as a minimum requirement.

In addition, students who major in Biochemistry must complete five trimesters, and those who minor, three trimesters, of the course Advanced Graduate Biochemistry.

A reading knowledge in one foreign language (French, German or Russian) is required.

## COURSE OFFERED

**ADVANCED GRADUATE BIOCHEMISTRY.** The content and time of the course are described on page 41 under "Interdepartmental Courses."

## Biology

Chairman: Professor Dorris J. Hutchison.

Professors: Frank W. Foote, Jr. (Pathology), Frank L. Horsfall, Jr. (Microbiology), Frederick S. Philips (Pharmacology), F. Kingsley Sanders (Cell Biology).

Associate Professors: Edward A. Boyse, Etienne de Harven, Jørgen E. Fogh (Microbiology), Peter J. Gomatos (Microbiology), Dorris J. Hutchison (Microbiology) Leopold G. Koss (Pathology), Alice E. Moore, Lloyd J. Old, H. Christine Reilly (Microbiology), Francis M. Sirotnak (Microbiology), Stephen S. Sternberg (Pathology), Leo Wade (Preventive Medicine), Ernest L. Wynder (Preventive Medicine).

Assistant Professors: Alberta M. Albrecht (Microbiology), June L. Biedler, Edward S. Essner, Wilbur F. Noyes III, Herbert F. Oettgen, Morris N. Teller.

Instructors: James G. Cappuccino, Elaine G. Diacumakos, George Sichuk.

The program in Biology is oriented toward an understanding of factors which initiate, control, and modify growth and biological development. Opportunity is offered for advanced work and research in cytology, genetics, virology, immunology, microbiology, endocrinology, and pharmacology.

Undergraduate prerequisites for a major in Biology include courses in inorganic chemistry, organic chemistry, qualitative and quantitative chemistry, physical chemistry, physics (mechanics, electricity, and magnetism; sound, heat, and light), mathematics (through calculus), and general biology or zoology or botany. If any of these requirements are not completed at the undergraduate level, they must be completed during the first year of graduate study.

Programs are determined individually on the basis of interest, training, and prior experience. Elective courses in basic medical sciences include those described for the Medical College. Formal graduate

courses, seminars, and tutorials are arranged with the faculties of the Sloan-Kettering Division and the Medical College.

## COURSES OFFERED

1. **CYTOLOGY.** A formal course in general animal cytology. The topics include cell theory, principles of light and electron microscopy, mitosis, cytogenetics, cellular fine structure, biochemical analysis and enzymology of organelles isolated by differential centrifugation, cytopathology, and cytology of cancer cells and tissue cultures.

2. **VIROLOGY.** A formal course in which major emphasis will be placed on the basic mechanisms in the biology of animal viruses. The topics to be considered include virus structure and composition; assay of viruses and viral-specific products; interaction of viruses with receptors and antibodies; syntheses of viral nucleic acids and proteins and assembly of viral particles; structural and functional alterations in viral-infected cells; pathogenesis of viral diseases; and viral genetics.

3. **TUMORIGENESIS.** A series of lectures dealing with carcinogenesis and related subjects. Topics include the nature of neoplastic changes *in vivo* and *in vitro*; comparison of chemicals, viruses, and physical agents; metabolism and mechanism of action of chemical carcinogens; and genetic, hormonal, and immunological factors involved in carcinogenesis.

4. **GENETICS SEMINAR.** The course is described on page 41 in the section "Interdepartmental Courses."

5. **IMMUNOLOGY.** A series of formal lectures in immunology, with special reference to immunobiology. Topics dealt with include immunological techniques, structure of antibodies, complement, immediate and delayed hypersensitivity, cellular basis of immune responses, ontogeny and phylogeny of the immune response, autoimmunity, immunological tolerance, immunogenetics, homotransplantation and tumor immunology.

## Biomathematics

Please refer to page 39 for complete listing of faculty, description of program, and courses.

## Biophysics

Chairman: Professor Edward R. Epp.

Professor: John S. Laughlin.

Associate Professor: Edward R. Epp.

Assistant Professors: Jerrold Fried, Harold Moroson, Ira Pullman, Roy S. Tilbury, Louis Zeitz.

Instructor: Peter J. Kenny.

Graduate work is offered leading to the Ph.D. degree in Biophysics and the M.S. in Radiation Physics.

Undergraduate prerequisites include courses in general physics, electricity and magnetism, mechanics, mathematics (through calculus), and thermodynamics, and acceptable laboratory experience in these subjects. If any of these requirements are not completed at the undergraduate level, they must be completed at the onset of graduate study.

Some of the research projects in Biophysics which are pertinent to the Ph.D. program include: studies of the metabolism of various isotope-labeled compounds in man; metabolism of biologically important compounds in tissue cultures of human tumor cells, in bacteria, and in viruses; the mechanism of radiation action on bacteria, phage, yeast, and small animals, including metabolic studies with human and other tumors influenced by radiation under different environmental conditions; fundamental radiobiological studies of mammalian cells in tissue culture, using synchronized cell populations and metabolic inhibitors; trace element analysis of tissue sections by means of fluorescent x ray spectrometers; electron spin resonance spectroscopy of free radicals in carcinogenic and irradiated compounds; study of the early radiation-induced processes in cells using high-intensity pulsed irradiation techniques; the investigation, using existing computer facilities, of mathematical models which simulate the behavior of biological systems, e.g., the proliferation of cells in human leukemia, the measurement of radiation by calorimetric, chemical, and solid-state techniques.

The course of study leading to the M.S. degree in Radiation Physics trains physicists in the various aspects of production, measurement, and application of radiation to various medical and biological problems. These problems particularly involve the use of radiation in the diagnosis and treatment of cancer. A variety of radiation sources are available, capable of generating photons and electrons with energies ranging from 5 Kev to 25 Mev and with electron dose-rates up to  $10^{14}$  rads per second. Experience is also provided in the handling and use of many different radioisotopes. The magnitude and variety of facilities and unique radiation projects at the Sloan-Kettering Institute and the Memorial Hospital are particular pertinent for training in this area. An important feature is the coexistence of fundamental research and practical and clinical applications in the same center.

## COURSES OFFERED

1. **RADIOLOGICAL PHYSICS.** Lectures and problems. A series of hourly lectures and assigned problems in applied mathematics, fundamentals of radiation physics, x ray and radium treatment planning, diagnostic x ray principles, radiation protection, and uses of radioactive isotopes.

2. **RADIOBIOLOGY.** A full-year course in fundamental radiobiology dealing with the effects of radiation on cells, viruses and on macromolecules, as well as on whole animals. The course also covers areas of radiation physics and radiation chemistry pertinent to radiobiology.

3. **ADVANCED BIOPHYSICS.** Laboratory courses in each of the topics of radiation biophysics.

4. **BIOPHYSICS COLLOQUIA.** Reports on research in progress by faculty and outside lecturers; required for majors in Biophysics.

## Biostatistics

Please refer to page 40 for complete listing of faculty, description of program, and courses.



# REGISTER OF STUDENTS

## DOCTORS OF PHILOSOPHY

- Gary Citrin, B.S. 1963, Brooklyn College of Pharmacy; Ph.D. 1967, Cornell University. Major: Pharmacology. Brooklyn, N.Y.
- Aristides, Costeas, B.S. 1958, University of Athens; M.A. 1964, Columbia University; Ph.D. 1968, Cornell University. Major: Biophysics. Nicosia, Cyprus
- Irene Lysloff Skipski, A.B. 1955, Temple University; Ph.D. 1968, Cornell University. Major: Biochemistry. New York, N.Y.
- Lloyd M. Stempel, B.S. 1956, The College of the City of New York; Ph.D. 1968, Cornell University. Major: Biochemistry. Brooklyn, N.Y.
- Barbara K. Urbaitis, B.A. 1960, Hunter College; Ph.D. 1968, Cornell University. Major: Physiology. New York, N.Y.

## MASTERS OF SCIENCE

- Anna B. Drakontides, B.A. 1955; M.A. 1960, Hunter College; M.S. 1968, Cornell University. Major: Anatomy. New York, N.Y.
- Cesar Wong-Chia, M.D. 1958, National University of Mexico; M.S. 1968, Cornell University. Major: Microbiology. Mexico D. F., Mexico.

## CANDIDATES FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

- Dianne D. Aronian, B.S. 1962, Westminster College. Major: Genetics. New York, N.Y.
- Fran Auerbach, B.S. 1965, Cornell University. Major: Microbiology. Huntington Station, N.Y.
- Richard Avenia, B.S. 1967, St. John's University. Major: Biochemistry. Valley Stream, N.Y.
- William F. Bowers, B.A. 1966, University of California (Berkeley). Major: Biochemistry. Boston, Mass.
- Nancy Jane Chew, B.A. 1963, University of North Carolina. Major: Biochemistry. Tallahassee, Fla.
- Augustus C. Damian, Jr., A.A. 1958, Silliman University; M.D. 1963, University of the Philippines. Major: Physiology. Quezon City, P.I.
- Joseph DiSalvo, B.A. 1966, New York University. Major: Physiology. Brooklyn, N.Y.
- Anna B. Drakontides, B.A. 1955; M.A. 1960, Hunter College; M.S. 1968, Cornell University. Major: Anatomy. New York, N.Y.
- Sister Ellen Marie Duffy, A.A. 1958, Mercy College; B.A. 1959, Manhattanville College; M.S. 1962, Catholic University of America. Major: Biochemistry. Dobbs Ferry, N.Y.

- June Kaiser Dunnick, B.S. 1965, Cornell University. Major: Microbiology. Locust Valley, N.Y.
- Janet L. Duyckinck, B.S. 1967, Bucknell University. Major: Biology. Clark, N.J.
- Robert A. Erlandson, B.A. 1959, New York University; M.S. 1963, Long Island University. Major: Cytology. Woodside, N.Y.
- Lorraine A. Flaherty, B.S. 1967, Jackson College (Tufts University). Major: Anatomy. Rutherford, N.J.
- Jerald D. Gass, B.S. 1957, University of Oklahoma; A.M. 1962, Harvard University. Major: Biochemistry. Oklahoma City, Okla.
- Anastasia Gregoriades, B.A. 1962; M.A. 1964, Hunter College. Major: Biology. New York, N.Y.
- Edwin C. Hahn III, B.A. 1958, Amherst College. Major: Microbiology. Scarsdale, N.Y.
- Melvin B. Hayes, B.A. 1964, Washington and Jefferson College. Major: Biochemistry. Dunns Station, Pa.
- Ellen D. Heller, B.A. 1967, Russell Sage College. Major: Anatomy. Hillside, N.J.
- Bernard Horowitz, B.S. 1966, University of Chicago. Major: Biochemistry. Philadelphia, Pa.
- Peter B. Jahrling, A.B. 1967, Cornell University. Major: Microbiology. Ridgewood, N.J.
- Mona D. Jensen, B.S. 1966, Massachusetts Institute of Technology. Major: Biochemistry. College Park, Md.
- Laura D. Kramer, B.A. 1967, University of Pennsylvania. Major: Microbiology. Muttontown, N.Y.
- Harriet R. Levie, A.B. 1960, Barnard College; M.A. 1964, Hunter College. Major: Biochemistry. New York, N.Y.
- Louise A. Lichtenberg, B.A. 1964, Oberlin College. Major: Biochemistry. Washington, D.C.
- Gesina L. Longenecker, B.S. 1965, Newcomb College. Major: Pharmacology. New Orleans, La.
- Neal A. Machtiger, B.S. 1966, Cornell University. Major: Microbiology. Valley Stream, N.Y.
- Stephen Margolis, B.A. 1963, Yeshiva University. Major: Pharmacology. New York, N.Y.
- Anne G. Mazelis, B.S. 1962, The College of the City of New York; M.S. 1964, University of Chicago. Major: Biochemistry. New York, N.Y.
- Arthur Myles, B.A. 1960, Middlebury College; M.A. 1962, Wesleyan University. Major: Biochemistry. Yonkers, N.Y.
- Robert C. Nowinski, B.S. 1967, Beloit College. Major: Biology. New Rochelle, N.Y.
- Margaret R. Payne, B.S. 1964, Medical College of Virginia School of Pharmacy. Major: Biochemistry. Richmond, Va.
- Lawrence M. Pinkus, B.A. 1966, Johns Hopkins University. Major: Biochemistry. Mohegan Lake, N.Y.
- Jeanne I. Rader, B.A. 1966, Syracuse University. Major: Microbiology. Hamburg, N.Y.
- Noel M. Relyea, B.A. 1968, Cornell University. Major: Biochemistry. Riverside, Ill.

- Paul G. Richman, B.S. 1967, Brooklyn College. Major: Biochemistry.  
Brooklyn, N.Y.
- Charles S. Rubin, B.S. 1965, University of Scranton. Major: Biochemistry.  
Scranton, Pa.
- Meryl A. Rubin, B.S. 1960, The College of the City of New York. Major: Biochemistry.  
New York, N.Y.
- Priscilla A. Schaffer, B.S. 1964, William Smith College. Major: Microbiology.  
Erie, Pa.
- David Soifer, B.S. 1961, Columbia University. Major: Anatomy.  
New York, N.Y.
- John Sweeney, B.S. 1967, Manhattan College. Major: Pharmacology.  
Brooklyn, N.Y.
- Elizabeth B. Thompson, B.A. 1964, Radcliffe College. Major: Microscopic Anatomy.  
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