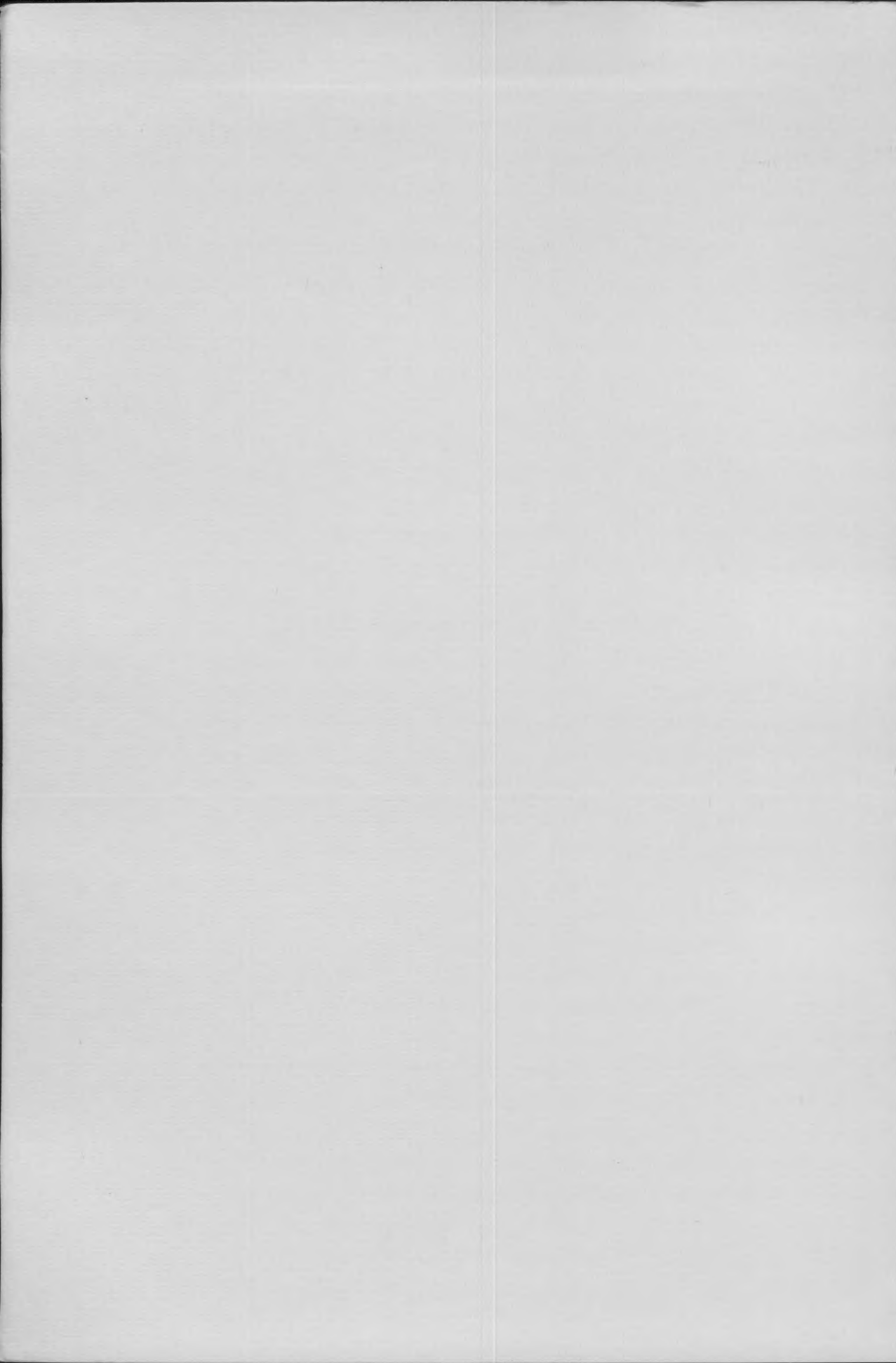


Cornell University  
Announcements  
Graduate School  
1973-74



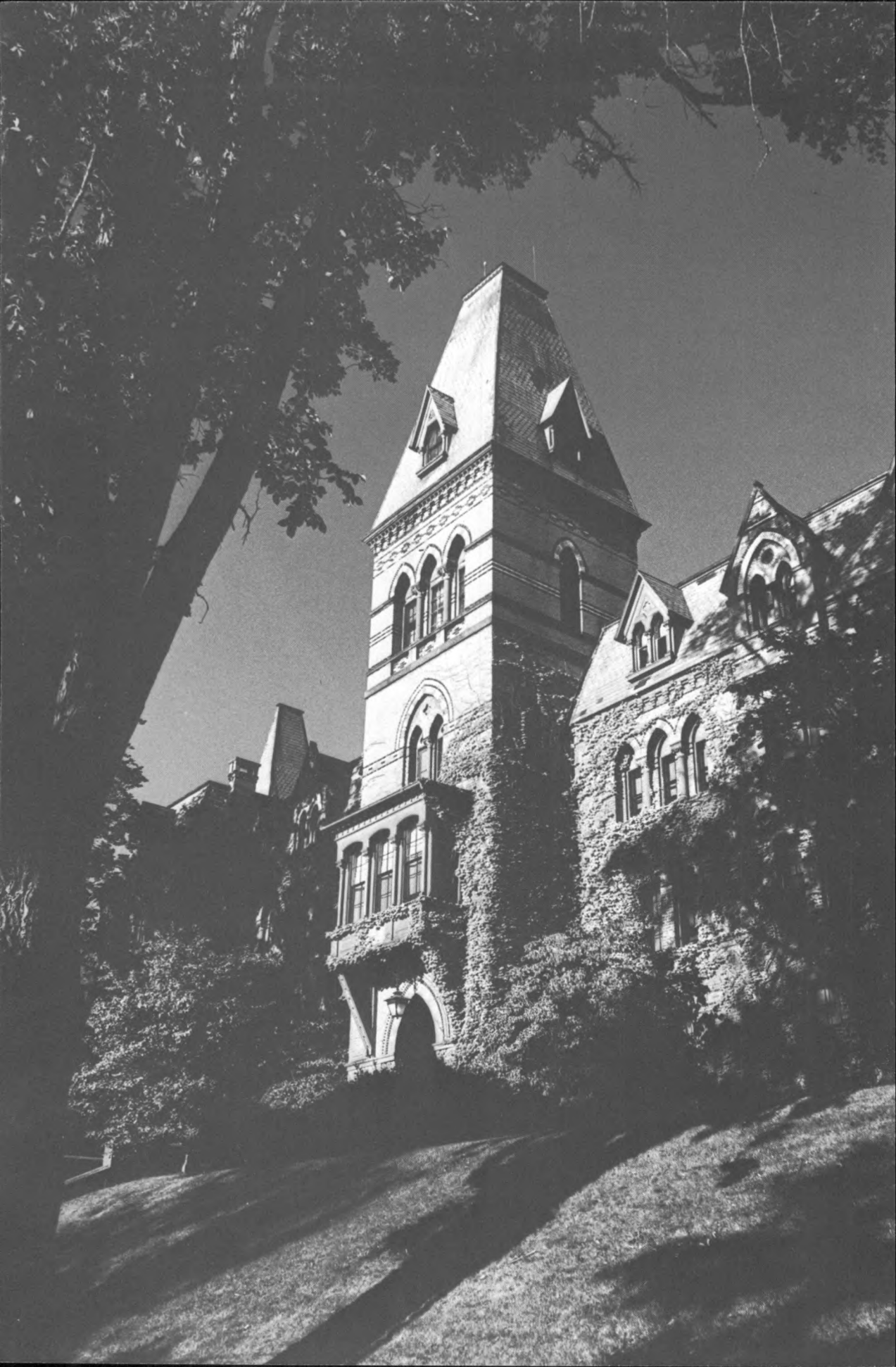
# Cornell University

## Graduate School

1973-74

### **Cornell University Announcements**

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# Contents

Graduate School Calendar	4
The Graduate School	7
Admission	7
Tuition and Fees	9
Financial Support	10
Degree Requirements	11
General Information	14
Advanced Professional Degrees	15
Graduate School of Medical Sciences	17
Special Resources for Research and Advanced Study	18
Fields of Instruction	26
Humanities	26
Social Sciences	35
Biological Sciences	51
Physical Sciences	64
Administration	76
Index of Fields and Major and Minor Subjects	77
General Index	81
List of Announcements	83

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

# Graduate School Calendar

1973-74

## *Fall Term*

Registration, new students	Thursday, August 30
Registration, continuing and rejoining students	Friday, August 31
Fall term instruction begins	Monday, September 3
Last day for filing statement-of-courses forms, change-of-committee forms, and nomination-of-committee forms	Wednesday, September 12
Last day for students to take admission-to-candidacy examination in order to have them considered by the beginning of the term	Monday, October 1
Last day for change of course registration	Friday, November 9
Thanksgiving recess:	
Instruction suspended, 1:10 p.m.	Wednesday, November 21
Instruction resumed	Monday, November 26
Fall term instruction ends, 1:10 p.m.	Saturday, December 8
Final examinations begin	Thursday, December 13
Final examinations end	Saturday, December 22
Last day for completing all requirements for a January degree	Friday, January 11

The dates shown in the Calendar are subject to change at any time by official action of Cornell University.

In enacting this calendar, the University Senate has scheduled classes on religious holidays. It is the intent of Senate legislation that students missing classes due to the observance of religious holidays be given ample opportunity to make up work.

### *Spring Term*

Registration, new and rejoining students	Thursday, January 24
Registration, continuing students	Friday, January 25
Spring term instruction begins	Monday, January 28
Last day for filing fellowship and scholarship applications for 1974-75	Friday, February 1
Last day for filing statement-of-courses forms, change-of-committee forms, and nomination-of-committee forms	Wednesday, February 6
Last day for students to take admission-to-candidacy examinations in order to have them considered by the beginning of the term	Friday, March 1
Last day for change of course registration	Friday, April 5
Spring recess:	
Instruction suspended, 1:10 p.m.	Saturday, April 6
Instruction resumed	Monday, April 15
Spring term instruction ends, 1:10 p.m.	Saturday, May 11
Last day for completing all requirements for a June degree	Friday, May 17
Final examinations begin	Friday, May 17
Final examinations end	Monday, May 27
Commencement Day	Monday, June 3

### *Summer*

Summer Research periods begins	Tuesday, May 28
Registration for Summer Session	Wednesday, June 26
Last day for filing statement-of-courses forms, change-of-committee forms, and nomination-of-committee forms	Wednesday, July 3
Summer Session ends	Friday, August 9
Last day for completing all requirements for an August degree	Friday, August 23
Summer Research period ends	Thursday, August 29



# Cornell University

## Graduate School

Graduate education at Cornell is based on the principle that no objective of a university lies deeper in its tradition or springs higher in its aspiration than does the nurture of scholarship. The advancement of learning, the methods of learning and the criticism of learning occupy the highest reaches of university life and work. Graduate education brings into fruitful contact the most distinguished scholars and the most advanced students, that learning may be shared and that wisdom may be at least glimpsed.

The Graduate School provides an environment within which scholarly capability is encouraged to emerge, thrive, and transmit itself. The School arranges a set of conditions congenial to the student who is prepared to profit from the availability of advanced courses of study; the opportunity for sustained reflection; the companionship of active, full-time fellow students; the most highly developed libraries, laboratories, and other facilities for research; the prospect of independent discovery or recovery, of evaluation or reevaluation; the daily presence of distinguished teachers; and the hope of attaining a firmly based structure of knowledge and a free and independent habit of judgment.

Freedom and independence are key qualities of scholarship, and graduate studies at Cornell are ordered so as to preserve them for both teacher and student. The Cornell principle is that scholars are begotten by other scholars, that judgments are formed by associating with the best judges, that learning lives in the unbroken succession of the learners and the learned, that genuine scholarship is always humane and rests ultimately on personal teaching and personal learning, that success in graduate studies must consist of satisfying the professor rather than a mute schedule of requirements. Graduate School standards are high, but they are maintained there not by the pronouncements of an office but rather by the men after whom such standards are themselves fashioned.

The Cornell graduate student selects not only the study he wishes to pursue, but also the scholar under whose tutelage he wishes to pursue it. The candidate himself, no one else, makes the choice. Some candidates when they apply for admission have in mind the faculty member with whom they wish to

study. Those who do not are granted, under a temporary adviser, a semester in which to form an acquaintance and to come to a decision. The supervising professor is called the student's chairman. The chairman and his associate or associates, also chosen by the student, form the student's Special Committee. All such matters as the outlines of study, the observation of progress, the setting of general examinations, the conduct of the thesis, and other exercises leading to a graduate degree are determined within this small circle—the student and the professors he has selected to direct him. So successful is this arrangement and so strongly does Cornell believe in it, that the Special Committee enjoys extraordinary freedom and independence in conducting the student to his degree. The Graduate School sets no course requirement, no credit-hours requirement, no grade requirement. Within the broad agreements of the graduate faculty concerning residence, oral examinations, and thesis, the student will be recommended for his degree whenever his Special Committee judges him ready to receive it. When the Committee is satisfied, the requirements are.

The responsibility for administration of policies, including the general requirements, the establishment of Fields and subjects of study, admissions, and maintenance of records is placed in the hands of the dean and his staff under the guidance of the General Committee of the Graduate School. These matters are described in detail in *The Code of Legislation*, copies of which may be obtained by enrolled students from the Graduate School Office.

*The University expects that all graduate students at Cornell University shall, at all times, act with a mature and morally responsible attitude, recognizing the basic rules of society and the common rights of others.*

### Admission

*It is the policy of Cornell University actively to support the American ideal of equality of opportunity for all, and no student shall be denied admission or be otherwise discriminated against because of race, color, creed, religion, sex, or national origin.*

## 8 Admission

Since instruction in the Graduate School is primarily individual, those interested in becoming students are encouraged to communicate with individual members of the faculty with whom they may want to study. Personal interviews in advance of formal application for admission are especially encouraged. For the benefit of those who are not acquainted with faculty members in the Field or Fields of their interest, each Field has selected a representative, as director of graduate studies, to whom inquiries may be addressed. Most students matriculate in the fall, and some Fields will not accept new students for the spring term; applicants should check with the Field representative before applying for spring admission.

An applicant for admission to the Graduate School must (1) hold a baccalaureate degree granted by a faculty or university of recognized standing or have completed studies equivalent to those required for a baccalaureate degree at Cornell, (2) have adequate preparation for graduate study in his chosen field of instruction, (3) have fluent command of the English language, (4) present evidence of promise in advanced study and research, and (5) have a combined score of 1200 in the Aptitude Test of the Graduate Record Examinations. Students from United States colleges and universities should be in the top third of their graduating class.

A catalog listing courses will automatically be sent to each student whose application for admission is approved. It is available to others upon request to the Graduate School Office.

### Categories of Admission

#### Degree Candidates

It is expected that most applicants for admission intend to pursue a program for an advanced degree. Applicants may specify candidacy for the Master of Arts or Master of Science or one of the professional master's degrees listed on p. 15. However, since Cornell has a strong commitment to doctoral work, most students are encouraged to enroll in a doctoral program. In some Fields, students registered in a doctoral program may be required to seek a master's degree as an initial step.

Only under unusual circumstances will any one who already holds an advanced degree be awarded the same degree.

#### Provisional Candidates

A qualified applicant whose academic background is difficult to evaluate may be admitted as a provisional candidate. Ordinarily only one semester of study in this status is permitted and the student who fails to qualify for candidacy at the end of that time may be requested to withdraw from the University.

#### Noncandidates

When staff and facilities are available, the Graduate School will admit some applicants who do not intend to work toward an advanced degree at Cornell but who have special objectives for formal study or scholarly work at the graduate level, provided they satisfy all the entrance requirements expected of

degree candidates. Registration as a noncandidate is restricted to two semesters.

#### Change of Status

A student who wishes to change status from a noncandidate to a degree candidate or from one degree or Field to another, or who, after receiving the master's degree, wishes to undertake candidacy for the doctorate, must submit to the dean of the Graduate School a written request giving reasons for the proposed change. A provisional candidate is automatically reviewed at the end of each semester; therefore, no letter is necessary.

### Application Procedures

Applications for admission should be requested from the Graduate School, Sage Graduate Center, Cornell University, Ithaca, New York 14850. Two letters of recommendation should be sent from the applicant's major instructors. Official transcripts from all the institutions of higher learning attended and, where required, the Graduate Record Examinations or the Miller Analogies Test scores complete the application.

All applications from residents or citizens of the United States or Canada must be accompanied by a \$20 nonrefundable fee. Applicants from other countries, if accepted for admission, must pay this fee before registration.

Fellowship applicants are especially urged to take the Graduate Record Examinations (GRE) Aptitude (Verbal and Quantitative) Tests of the Educational Testing Service no later than December, and to have the scores sent to the Cornell Graduate School as part of their application materials. Information about the times and places of test administrations may be obtained directly from the Educational Testing Service, Princeton, New Jersey 08540. The Field listings, pp. 26 ff., should be consulted for Fields requiring the scores of both the Aptitude Test and the pertinent Advanced Test.

Foreign applicants whose native language is not English and who have received their secondary school or advanced education in the English language should submit to the Graduate School a statement to this effect signed by a responsible officer of a United States embassy or consulate or by an appropriate official of the educational institution involved. If English has not been the medium of instruction, applicants must take the Test of English as a Foreign Language by arrangement with Educational Testing Service, Princeton, New Jersey 08540. This test, available throughout the world, is given four times a year; information on times and places may be obtained directly from the address given above. The test score must be reported directly by the testing organization to the Graduate School; since this test is diagnostic, no final action on applications will be taken until the scores have been received. If the scores indicate unsatisfactory command of English, admission may be denied, or it may be made contingent upon evidence of improvement. The usual minimum score on this test is 550.



## Tuition and Fees

*All statements in this section are prepared by the University bursar, who alone is authorized to interpret them. Tuition or fees may be changed by the trustees at any time without previous notice.*

Tuition becomes due when the student registers. Any student who fails to pay his tuition to the University at the Bursar's Office within the prescribed period of grace will have his registration in the University terminated unless the bursar has granted him an extension of time to complete payment. The bursar is permitted to grant such an extension when, in his judgment, the circumstances of a particular case warrant his doing so. For any such extension the student is charged a fee of \$5. A reinstatement fee of \$10 is assessed against any student who is permitted to continue or return to classes after his registration has been terminated for default in payments. The assessment may be waived in any instance for reasons satisfactory to the bursar when such reasons are set forth in a written statement.

If a graduate student terminates a University registration for a regular term by official Leave of Absence or Withdrawal, tuition will be charged beginning with registration day to the effective date of the certificate of Leave of Absence or Withdrawal issued by the Graduate School as follows (for each week or fraction of a week): first week 10 percent, second week 20 percent, third week 30 percent, fourth week 40 percent, fifth week 60 percent, sixth week 80 percent, seventh week 100 percent, except that no charge will be made if the effective date is within the first six days of the term, including registration day. No part of the registration or matriculation fee is refundable. Graduate students must arrange for withdrawal or leave of absence at the Graduate School Office.

Students registering at any time during the last ten weeks of any term pay at the rate of 10 percent of the regular tuition for the term for each week or fraction of a week from the day of registration through the last examination day of the term.

### Registration Deposit

Every applicant for admission must make a deposit of \$50 after receiving notice of acceptance, unless he has previously matriculated as a student at Cornell University. This deposit is used at the time of first registration to pay the matriculation fee, chest x ray, and examination-book charge, and covers certain expenses incidental to graduation if the student receives a degree. The deposit will not be refunded to any candidate who withdraws his application after May 10 or more than fifteen days after his admission approval. This fee is not covered by University fellowships, scholarships, or assistantships.

### Tuition

The amount of the tuition charge depends on the student's major field. Tuition is \$1,500 each term for all students registered in the Graduate School except

those with major work in the Graduate School of Nutrition, the Field of Education, the Division of Biological Sciences, and those enrolled in a Master of Arts in Teaching program are all charged \$700 a term. Those whose major chairman is on the faculty of the statutory divisions of Agriculture and Life Sciences, Human Ecology, and Industrial and Labor Relations are also charged \$700 a term. Those whose major chairman is on the faculty of the statutory division of Veterinary Medicine are charged \$900 a term.

Upon recommendation of the appropriate college dean and approval of the controller, a student who is a teaching or research assistant in one of the statutory divisions may have a partial waiver of tuition in the Graduate School if the major field of study is in a statutory division.

Assistants in statutory schools or colleges who are on twelve-month appointments and who are registered for Summer Research for credit in the Graduate School may be recommended for waiver of tuition during the summer period under the above limitations. This waiver of tuition does not apply if the student registers in the Summer Session or is not doing productive work for the department.

Any student who is to receive less than full residence credit because of his employment should apply for proration of tuition on forms procurable at the Graduate School Office. Tuition is based on residence eligibility (see p. 13).

### Candidate for Degree Only

A graduate student who returns to the University to present his thesis and to take the final examination for an advanced degree, all the work for that degree having been previously completed, must register as a Candidate for Degree Only and pay a fee of \$35.

### Thesis Fee

Each doctoral candidate must pay \$30 when he deposits the approved thesis and abstract in final form. This fee covers the cost of preparing a master microfilm of the entire thesis; of publishing the abstract in the monthly periodical *Dissertation Abstracts International*; of mailing the microfilm and abstract to the microfilm publisher; and of binding both copies of the thesis for deposit in the University Library.

### Summer Session

Graduate students who attend classes in the Summer Session must register both in the Graduate School and in the Summer Session; they must pay the tuition and fee listed in the *Announcement of the Summer Session*.

### Summer Research

Students registered for Summer Research pay a prorated tuition, based on tuition in effect for the



## 10 Financial Support

subsequent academic term, if they are obtaining residence credit, but not otherwise.

### In Absentia

A graduate student registered in absentia pays a fee of \$35 each term.

## Financial Support

*The deadline for applying for fellowships is February 1. No special forms are available for financial aid. The applicant should check the type or types of financial aid for which he wishes to be considered on the application for admission form.*

Extensive financial resources are available to help Cornell graduate students with educational costs. Currently, approximately 2,900 of the 3,400 graduate students receive financial aid in the form of fellowships, teaching assistantships, and research assistantships. However, the amount of support available from outside the University is contracting sharply, so the number of students with fellowships or assistantships is expected to decrease.

In most cases the stipends awarded to graduate students are not high enough to cover living expenses completely, and other sources of supplementary income, such as loans, are often necessary. A great deal depends on the standard of living to which the individual is accustomed and the sacrifices he is willing to make for his education. Experience has shown that married students with dependent children have particular financial difficulties. The minimum subsistence income which married students need is about \$5,000 plus tuition per academic year.

Since the demands of graduate study are so great, students are discouraged from trying to support themselves by unrelated employment.

### Teaching Assistantships

The duties of a teaching assistant normally involve classroom and laboratory instruction of undergraduates and thus play a major role in the educational process and the academic atmosphere of the University. Since a majority of Cornell's graduate students eventually seek teaching careers, the experience gained from these appointments is invaluable. In most Fields students are encouraged to spend some time in teaching, and in some Fields the faculty believe the experience so important that they require it of all students in doctoral programs. An appointment as a teaching assistant is usually in the student's major Field or in a closely related one. The duties require ten to twenty total clock hours of the student's time a week, depending on the Field. A teaching assistant whose duties are in his major Field of interest and do not exceed twenty hours is eligible for full residence credit. Salary is \$2,700 for a fifteen-hour week, or slightly higher for longer hours, and is supplemented by a fellowship which covers tuition. Because of possible problems in communication with undergraduates, applicants from

non-English-speaking countries are not normally appointed as teaching assistants in their first year at Cornell. Teaching appointments are made by department chairmen. Applications for these positions should be made to the Field representative of the student's major Field.

### Research Assistantships

The duties of a research assistant involve work on a research project. This work is frequently applicable to the student's thesis research and is under the direction of the chairman of his Special Committee. The student is required to spend twenty hours a week, but if the research is in the Field of his major interest he can earn full-time residence credit. In many Fields such appointments are normally made after completion of at least one year of graduate study.

### Fellowships

A fellowship ordinarily is awarded in open competition to a full-time student who is a candidate for a higher degree (usually a Ph.D.), primarily on the basis of scholastic ability and promise of achievement. The award is made as a tax-exempt gift, and it usually not only covers tuition but also may provide a substantial stipend for living expenses. A student who holds a fellowship is free to select his own research project, subject to approval of his Special Committee, and his primary responsibility is to study for his degree. The award of the fellowship does not obligate the holder to render services to the University, except that in certain Fields some teaching is required of all graduate students for the sake of experience and training, nor is the holder of a fellowship committed in any way with respect to future employment. The holder of a fellowship may accept no other concurrent appointment or employment without permission of the Cornell Graduate Fellowship Board; however, teaching responsibilities will usually be approved as a routine matter if they contribute to the student's graduate program and do not exceed ten clock hours of work per week.

More than 300 fellowships are under the direct supervision of the Fellowship Board or of academic units of Cornell. The range of stipend (in addition, to tuition and, in some cases, dependency allowances) for different categories of fellowships available to first-year students is as follows: Cornell Andrew D. White Fellowships—\$2,500–\$3,000; Cornell Graduate Fellowships—\$2,000; Cornell fellowships from special endowments—\$1,000–\$2,000; industrial fellowships—\$1,500–\$2,500. Many other fellowships are offered to students majoring in certain Fields of study, and some of these are noted in the descriptions of the Fields.

Many private and federally supported fellowships are also administered by the Graduate School. The application deadline for these is February 1 for the following academic year; candidates for these fellowships are nominated by the Field from among those students applying. National Institutes of Health Traineeships are available and are offered by Fields which have been awarded such grants.

Also available are National Defense Education Act Title VI (NDFL) Fellowships. The purpose of the NDFL program is to provide encouragement to individuals taking advanced training in languages and in associated area studies designated as being of critical importance to the United States.

Prospective graduate students should also consider applying for fellowships awarded on a national basis by the National Science Foundation, the Woodrow Wilson National Fellowship Foundation, and the Ford Foundation. These programs have deadlines for applications, some as early as December 1. Applicants should check on the date pertinent to the fellowship. In some cases a winner of an NSF award can hold a half-time appointment as a teaching fellow for an additional stipend.

As agreed upon by some of the members of the Council of Graduate Schools in the United States, the regular time for notification of award from Cornell of fellowships and scholarships for the succeeding academic year is April 1. All fellowship and scholarship applications received by February 1 will be considered for April awards, and every effort will be made to notify each applicant approved for award no later than April 6 as to whether he has a fellowship or is named as an alternate. Awardees should notify the Graduate School no later than April 15 of their acceptance or rejection of the award; failure to do so will be considered a declination. Applications received after February 1 will be considered only if vacancies occur.

### Minority Group Fellowships

The Fellowship Board has recently awarded a number of fellowships to applicants from minority groups who were not offered support through the regular channels (regular fellowships, traineeships, teaching and research assistantships, etc.). The student does not apply for these fellowships directly, but is nominated by the Field to which he was admitted.

Graduate Fellowships for Blacks from Southern Africa are also available to qualified applicants of this origin.

### Residence Hall Assistantships

Approximately twenty-five resident hall assistantships are available for single or married men and women graduate students in any academic field. These positions are most appropriate for students who desire experience in working with undergraduate students and University staff.

Remuneration includes payment of a partial tuition grant plus a board supplement and a stipend which varies according to responsibilities. Details about the assistantships and application forms may be obtained from the Office of the Dean of Students, Barnes Hall. Positions are generally only available for second-year graduate students. A personal interview is required of all applicants.

### Prizes

Several University prizes are open for competition to graduate students. A booklet, *Prize Competitions*,

which describes all regularly established prizes, may be obtained from the Visitor Information Center, Day Hall.

### Scholar Incentive Payments

Students who are legal residents of New York State may be eligible for Scholar Incentive Payments; information and application forms may be obtained from Regents Examination and Scholarship Center, 99 Washington Avenue, Albany, N. Y. 12210.

### Loans

Only graduate students duly registered in a degree granting program are eligible for loans. Provisional or noncandidate students are not eligible. Applications for the National Student Loan Program and for University loans are available at the Office of Scholarships and Financial Aid, 105 Day Hall; the application date is the mid-April prior to the student's September matriculation. Increasingly the University is referring both undergraduate and graduate students to their state loan program sponsored under a federal program. Applications for this program may generally be obtained from the student's home bank.

### Part-Time Employment

Opportunities for part-time work are often available in connection with departmental research projects or other activities. Applications for this type of work should be made directly to the department concerned or to the Office of Scholarships and Financial Aid, Day Hall. A candidate may find employment in research or other work closely allied to his academic interest valuable; on the other hand, progress in candidacy is difficult when a student attempts to support himself wholly or partially by work unrelated to his studies.

### Employment for Spouses of Students

Cornell University offers some nonacademic positions for working wives through the Personnel Department, B-12 Ives Hall.

In addition, the Ithaca area offers opportunities for positions in small industrial plants, at Ithaca College, the local hospital, and various businesses. Applicants should go to the New York State Employment Office for further information regarding these opportunities.

## Degree Requirements

### The Special Committee

The general degree requirements of the Graduate School are kept at a minimum in order to give the student maximum flexibility in choosing a desirable program of studies. Since progress in graduate study depends so much on the individual student's situation, no course or grade requirements are imposed by the Graduate School. The student's program is developed with the aid and direction of a

## 12 Degree Requirements

Special Committee which he chooses from members of the graduate faculty, and is designed to fit his specific needs and desires. Satisfactory progress toward the degree is judged solely by the Special Committee rather than by arbitrary standards imposed by the Graduate School.

The Special Committee under which a Master of Arts or a Master of Science candidate carries on his work is composed of a chairman who represents the major subject, and one representative of an appropriate minor subject. The Special Committee of a doctoral student is composed of a chairman, representing the major subject, and two other members representing other areas of interest. The chairman of the Special Committee directs the student's thesis research. Some Fields require two minor subjects for doctoral programs while others require only one, but all Ph.D. Special Committees have three members.

The Field and the major subject, as well as the chairman of the Special Committee, are selected by the incoming student. It is his privilege to ask any member of the graduate faculty in the Field of his major subject to serve as his chairman. The chairman, in turn, advises the student about minor subjects and faculty members who might represent them on his Special Committee. The organization of the Graduate School at Cornell is based on a concept of fields of study independent of colleges and departments, so the student may take courses in any division of the University and may choose major and minor subjects without regard to organizational lines. The choice of major and minor subjects and the formation of the Special Committee must be recorded in the Graduate School Office within two weeks of the beginning of residency. Since the student may be uncertain of his aspirations at that time, he is encouraged to change the membership of his Special Committee as his aims become more definite.

In some of the larger graduate Fields the difficulty in making a wise selection of a Committee is so great that the Field representative or other faculty member may serve temporarily as the chairman while the student seeks a permanent chairman and Committee.

The members of the Special Committee direct the student's program and decide whether he is making satisfactory progress toward the degree. They conduct and report on oral examinations, and they approve the thesis. The Committee and the student constitute an independent working unit. All members of the graduate faculty, however, are free to participate in the scheduled examinations and review the theses of candidates for degrees.

### Residence

The graduate faculty regards study in residence as essential. Although a person working off campus may become proficient in a technique or even in a field of knowledge, he may fail in other ways to attain the breadth of knowledge necessary for scholarly work. In addition to use of the libraries and physical facilities of the University, he needs persistent and continuing interaction with others engaged in

similar pursuits. He should form the habit of attending lectures, seminars, and meetings of groups in whose activities he takes interest.

All students using University facilities must register and must pay tuition until the completion of their program unless they withdraw or are granted a leave of absence. Candidates for the Ph.D. degree normally take four or five years of satisfactory full-time study to complete all the degree requirements (the minimum residence requirement is six units). Candidates for the M.A. or M.S. degree normally take between one and two years of satisfactory full-time study to complete the degree requirements (the minimum is two units). Full-time study for one semester with satisfactory accomplishment constitutes one residence unit.

A student must complete all the requirements for the master's degree in four years and for a doctoral degree in seven years from the date of first registration in the Graduate School.

A student in a doctoral program may earn no more than two units, and a student in a Master's program no more than one, for all work done in Summer Research, Summer Session, and the Division of Extramural Courses. At least four of the six units required for the Ph.D. degree must be earned as a full-time student, earning three-quarters of a residence unit or more each term, and two of the last four units must be earned in successive terms of full-time study on the Cornell campus.

### Transfer of Residence

A candidate for the Master's degree may not count study in other graduate schools as part of his residence. A candidate for the doctorate may be permitted to count study for the Master's degree, if it is relevant to his doctoral program, as equivalent to two residence units, or more in exceptional cases. No commitment regarding transfer of residence may be made until after the student has entered into residence and his Special Committee has had opportunity to judge his accomplishments. The residence transferred must not exceed that which would have been earned under similar circumstances at Cornell, and no credits will be allowed for study as an undergraduate or as a special student.

### Summer Session

To receive residence credit for the Summer Session, the candidate must register in both the Summer Session and the Graduate School and must file a statement of courses satisfactory to his Special Committee. A student may, with prior approval of his Special Committee, earn one-half of a residence unit by completing eight hours or more of credit in the eight-week session, or two-fifths of a unit for six hours or more in the six-week session, but no more than two units in a twelve-month period. Residence may be transferred for study during one Summer Session preceding matriculation in the Graduate School if this study is an integral part of the graduate program subsequently undertaken, and if the transfer is recommended by the student's Special Committee and approved by the dean of the Graduate School.

### Summer Research

To encourage students to continue their studies during the summer period, no tuition or fees are charged for Summer Research if the student has been registered during the previous academic year. Substantial funds are also available for Summer Research support. The student registered for Summer Research on a non-credit basis has access to the regular services of the University clinic and infirmary during the summer without charge if he has been registered as a full-time student during the previous academic term. Under certain conditions, students may accumulate residence credit in Summer Research.

### Part-Time Studies

Essentially, all graduate students at Cornell are full-time students. If employment is necessary, students may hold positions requiring up to ten hours of work per week without reduction of residence credit. Teaching and research assistants whose duties require up to twenty hours a week can obtain full residence credit.

Part-time employees are eligible for residence units as follows.

Employment	Residence	Units	Allowable	per	Semester
Total clock hours per week	Contributory in the major field of study and on campus	Noncontributory but on campus	Off-campus		
0-10 hours	1 unit	1 unit	1 unit		
11-20 hours	1 unit	$\frac{3}{4}$ unit	$\frac{3}{4}$ unit		
21-30 hours	$\frac{3}{4}$ unit	$\frac{1}{2}$ unit	(See below)		

Those employed for more than twenty clock hours per week off campus, or more than thirty clock hours per week under any circumstances, may earn a maximum of two-fifths of a residence unit per semester through registration in the Division of Extramural Courses, but this will be permitted only on the basis of petition approved before the work is undertaken.

Students enrolled in the Division of Extramural Courses are not legally graduate students, but may accumulate residence units. Fifteen credit hours completed through the Division of Extramural Courses are equivalent to one residence unit, and six credit hours are equivalent to two-fifths of a unit—the smallest fraction that will be recorded by the Graduate School toward fulfillment of residence requirements. Detailed information concerning extramural courses and registration procedures may be obtained from the Division of Extramural Courses, B-20 Ives Hall.

### Examinations

The Special Committee conducts the examinations required for the degree. At the discretion of the Special Committee these examinations may be entirely oral or both oral and written.

For the Master's degree a final examination is required, which under certain conditions may be combined with the admission to (Ph.D.) candidacy examination.

Two examinations are required for the doctoral degree. A comprehensive admission to candidacy examination for formal admission to doctoral candidacy is taken after two units of residence credit have been accumulated but before the beginning of the student's seventh unit of residence. Two units of residence must be credited after this examination. A final examination, given after completion of the doctoral dissertation, covers subject matter related to the dissertation topic.

In some Fields a qualifying examination is given at an early date to determine the student's fitness for advanced study and to help the Special Committee plan his program.

In Fields that so desire, the Special Committee may, after the admission to candidacy examination has been taken, nominate the student for a Master's degree without the requirement of a thesis, provided that the student does not already hold such a degree granted by another institution. The Master's degree may be given whether or not admission to candidacy for the Ph.D. has been approved; it would be awarded after the completion of four units of residence.

### Foreign Language Requirements

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

Courses designed to aid graduate students in learning to read French, German, Russian, and Spanish are given by the Department of Modern Languages and Linguistics in cooperation with the graduate faculty.

### Thesis

Candidates for the degree of Master of Arts or Master of Science are required to submit a thesis in fulfillment of the requirements for the degree (except as stated above). Some Fields also require a thesis for professional Master's degrees. Candidates for the doctoral degree must complete a thesis which constitutes an imaginative contribution to knowledge. The faculty requires publication of Ph.D. theses by abstract or microfilm.



## General Information

### Courses and Grades

The Graduate School is not a course-offering agency. Therefore, students wishing information about courses or grades should inquire at the Office of the Registrar. However, the graduate faculty has ruled that a course may not be dropped or changed from credit to audit after the tenth week of classes.

### Living Arrangements

Further information about and application forms for the University housing described below, may be obtained from the Housing Services Office, 223 Day Hall.

### Dormitory Accommodations

Sage Graduate Center has dormitory facilities accommodating approximately 190 men and women. Cascadilla Hall has accommodations for approximately 160 men and women.

### Family Accommodations

The University has three apartment developments for married students and their families. They are Cornell Quarters, Pleasant Grove Apartments, and Hasbrouck Apartments, with housing for a total of 420 families. All apartments are unfurnished.

### Off-Campus Housing

The Housing Services Office maintains a board with voluntarily listed accommodations. Because available accommodations change constantly, it is not practical to mail listings, nor is it feasible to maintain a waiting list of persons seeking accommodations.

### Health Requirements on Entrance

Each entering graduate student must submit a health history, on the form supplied by the University. Tetanus immunization, while not required, is strongly advised; either primary or booster immunization may be obtained at the Gannett Clinic at a nominal charge. A student who is returning to the campus after more than one year's absence must submit an interim health history. Failure to fulfill the health requirements may result in loss of the privilege of registering the following term.

### Health Services and Medical Care

Health services and medical care for students are centered in two Cornell facilities, the Gannett Medical Clinic (outpatient department) and the Sage Infirmary.

Students are entitled to unlimited visits at the Clinic. Appointments with individual doctors at the Clinic may be made by calling or going there in person. An acutely ill student will be seen promptly whether he has an appointment or not. Students are also entitled to laboratory and x-ray examinations indicated for diagnosis and treatment, hospitalization in the Sage Infirmary with medical care for a maximum of

fourteen days each term, and emergency surgical care.

If a student prefers to consult a private physician rather than go to the Clinic, or to have the services of a private doctor while a patient in Sage Infirmary, he must bear the cost of these services.

On a voluntary basis, insurance is available to supplement the services outlined above. Information about this insurance may be obtained at the Gannett Clinic where a representative of the insurance company has an office.

If, in the opinion of the University authorities, the student's health makes it unwise for him to remain in the University, he may be required to withdraw.

### Motor Vehicles

The University does not encourage student use of motor vehicles but recognizes that in certain cases there may be important reasons why a student needs a motor vehicle. University regulations apply to all types of motor vehicles, including automobiles, motorcycles, motor bikes, and motor scooters.

Every Cornell student who operates or parks, or whose vehicle is operated or parked on the University campus at any time, must register that vehicle with the Traffic Bureau. Registration must be completed during the time designated for academic registration at the beginning of the student's first term, or within five days after acquiring a vehicle or otherwise becoming subject to registration requirements during the term.

The sticker which the student receives when he registers his vehicle is not a parking permit. Except for those holding special parking permits, no student shall park his motor vehicle on the grounds of the University during the hours from 8:00 a.m. to 5:00 p.m. Monday through Friday or from 8:00 a.m. to 1:00 p.m. on Saturday (except in posted unrestricted time zones and/or unrestricted metered parking spaces).

A complete list of regulations is found in the pamphlet *Regulations Governing Motor Vehicles*, which is made available at registration. Correspondence regarding motor vehicles should be addressed to the Traffic Bureau, G-11 Barton Hall.

### Activities for Graduate Students

Cornell students enjoy the advantages of a small academic community while having access to many cultural events that rival those of any large city. Lectures, movies, dramatic productions, special art exhibitions, and concerts fill the University's weekly calendar. The Bailey Hall Concert Series brings internationally famous artists and orchestras to Ithaca.

Many graduate students participate with undergraduates in extracurricular activities such as intramural sports, Glee Club, Sage Chapel choir, publications, music, and folk dancing. A Graduate Student Activities Committee is active in scheduling weekly social events. A Graduate Wives' Club promotes activities for the wives of graduate students.

Willard Straight Hall and the Sage Graduate Center provide facilities for graduate groups and aid in planning special functions for them. The Office for the Coordination of University Religious Affairs, located in Anabel Taylor Hall, serves as an information and referral agency for the varied religious activities which take place on campus. Seventeen religious groups together form a Council of Federated Ministries, with chaplains and faculty advisers who are available for counseling graduate students. The Centre for Religion, Ethics, and Social Policy, also headquartered in Anabel Taylor Hall, is open to graduate students in the realm of their social concern and activities.

Cornell's location in the Finger Lakes Region of New York State encourages outdoor activity. Many swimming and boating facilities are available. In addition, Cornell operates a private eighteen-hole golf course; indoor swimming facilities; an indoor skating rink; tennis, handball, and squash courts; a gymnasium; and riding stables. Several ski resorts also operate nearby.

## Counseling

The University maintains a variety of counseling services available to graduate students. A student's primary academic counselors are the members of his Special Committee. Other counselors who are able to help in matters of various kinds will be found in the Office of the Dean of Students, the Office of Scholarships and Financial Aid, the International Student Office, the Gannett Medical Clinic, the Sage Graduate Center, and the Religious Affairs Office in Anabel Taylor Hall.

## International Student Office

Cornell has, since its founding, welcomed students from abroad. Currently about 1,200 foreign students representing 92 countries are pursuing study in a variety of fields.

In addition, each year more than one hundred faculty members spend some time abroad in study and research, often in close association with foreign universities. This creates within the University community opportunities for students to meet and exchange ideas with members of the Cornell faculty who have firsthand knowledge of several countries and understand and appreciate a variety of cultures.

Special programs within the Graduate School permit study in depth of particular areas such as Africa, Asia, Southeast Asia, and Latin America (see pp. 18 ff.). Students from these areas have an opportunity to contribute to such programs.

Ithaca families participate in a Host Family Program where foreign students are invited to share in some aspects of American family life in the Ithaca community. Tours of the community are conducted at the beginning of the fall semester. Ithaca, because of the University, tends to have a more cosmopolitan atmosphere than most other small cities, and a student can usually find an outlet for a wide variety of interests.

The International Student Office is located in 200 Barnes Hall. Students from abroad are asked to report to this Office upon arriving in Ithaca and are invited to consult the staff at any time on questions they may have. This Office also works closely with academic advisers and sponsors, and with persons involved in a variety of student and community programs which enrich the cultural life of Cornell.

## Career, Summer Plans, and Placement Center

The Career, Summer Plans, and Placement Center at 14 East Avenue is an information center and a clearing house for jobs in business, industry, government, and teaching, as well as for study programs leading to the professions, fellowships, and summer experiences (work, study, travel, service projects). Students and faculty may keep up to date on the activities of the Center by registering to receive its *Newsletter*. Alumni may be served by either the *Job Bulletin* or the *Registrants Available Bulletin*.

## Advanced Professional Degrees

Advanced professional degrees are designed as preparations and training for a special profession.\* The admissions, requirements, and curricula for such degrees, as approved by the graduate faculty, are announced by the faculty of a professional school or college, which, for this purpose, acts as a division of the graduate faculty. Degrees are awarded upon recommendation of the division to the graduate faculty. Detailed information regarding admission or academic requirements for any professional degree is included in the *Announcement* of the separate school or college in which the degree is offered. Inquiries addressed to the Graduate School will be forwarded to the proper official. The professional degrees listed below are approved by the graduate faculty.

### Africana Studies

**Master of Professional Studies (African, Afro-American) [M.P.S. (A.A.A.)].** The program leading to this degree is intended to prepare students for teaching, research, and other professional careers related to Black studies. Degree requirements include thirty hours of course work (or equivalent), at least one year in residence, and the completion of a

\*The following are advanced degrees that are also first degrees of a school or college and therefore are not subject to the jurisdiction of the graduate faculty. For information regarding these degrees, address the school or college indicated.

Master of Engineering (Aerospace): Graduate School of Aerospace Engineering  
Master of Business Administration, Master of Public Administration, Master of Professional Studies (Hospital and Health Services Administration): Graduate School of Business and Public Administration  
Doctor of Law: Law School  
Doctor of Medicine: Medical College, New York City  
Doctor of Veterinary Medicine: Veterinary College

## 16 Advanced Professional Degrees

Master's thesis. Detailed information may be obtained from the Africana Studies and Research Center, 310 Triphammer Road.

### Agriculture

#### **Master of Professional Studies (Agriculture)**

**[M.P.S. (Agr.)].** This degree is intended for professional agriculturists seeking opportunity to study in depth some subject or problem which is pertinent to their profession. Detailed information may be obtained from Director Herbert L. Everett, 192 Roberts Hall.

### Architecture, Fine Arts, City and Regional Planning

The following three degrees are administered by the Division of Architecture, Art, and Planning of the Graduate School. Inquiries should be addressed to the department chairman.

**Master of Architecture [M.Arch.].** Training in architectural design, urban design, and regional design. Only graduates of a professional program in architecture, city planning, or landscape architecture are admitted as candidates. Others may be admitted as noncandidates or as undergraduate transfers and will be required to complete additional coursework before application for admission to the degree program.

**Master of Fine Arts [M.F.A.].** Advanced training in the practice of painting, sculpture, or graphic arts.

**Master of Regional Planning [M.R.P.].** Training for a professional career in the field of planning; in the public sector at the city, regional, or national level.

### Communication Arts

#### **Master of Professional Studies (Communication Arts)**

**[M.P.S.(C.A.)].** The focus of this program is more on the *strategic application* of communication knowledge and technology than on technical competence in media operation. The curriculum is designed for those students who wish to work with agencies in which organized public communication is a key concern. Emphasis is placed on three key elements: (1) analysis of what is known about the communication process, (2) exploration of the potential of current and new communication techniques and technology, and (3) application of the first two elements to specific communication problems.

### Education

**Master of Arts in Teaching [M.A.T.].** The program for this degree, administered by the Field of Education, is designed for and limited to those preparing for teaching the following subjects only in secondary schools: agriculture, biology, chemistry, earth science, English, French, home economics, physics, and social studies. The student and his Special Committee will select those courses and seminars in his teaching specialty and in education which are deemed most appropriate for developing competence

as a teacher. The student will be required to demonstrate his teaching skill in a supervised field experience. Completion of two regular semesters and one summer of full-time study, or two and two-fifths residence units is required. Graduates of a teacher-training program are ordinarily not eligible for this degree.

**Doctor of Education [Ed.D.].** The program for this degree, administered by the Field of Education, is designed to prepare the candidate within a broad cultural context for positions of professional leadership in education. The program of studies must include advanced work in each of the following: educational psychology, history or philosophy of education, educational measurement and statistics, and research in education. At least fifteen hours of credit must be earned in courses other than those in professional education. A minimum of sixty-five credit hours beyond the Bachelor's degree is required, of which thirty-five hours should be completed beyond the Master's degree or its equivalent. A candidate is required to complete a minimum of five residence units beyond the Bachelor's degree and a year of directed field experience.

**Master of Science for Teachers [M.S.T.].** This is a coordinated program of training in the biological and physical sciences for practicing teachers. Each degree candidate must satisfy a broad core program in mathematics and science and complete advanced work in his selected field of study. This degree is administered by the Division of Professional Teaching of the Graduate School. Detailed information may be obtained from the Graduate School Office, Sage Graduate Center.

### Engineering

**Master of Engineering.** The Master of Engineering degree is administered by the Engineering Division of the Graduate School. Specially oriented graduate programs lead to the following professional Master's degrees: Master of Engineering (Agricultural), Master of Engineering (Chemical), Master of Engineering (Civil), Master of Engineering (Electrical), Master of Engineering (Engineering Physics), Master of Engineering (Industrial), Master of Engineering (Materials), Master of Engineering (Mechanical), Master of Engineering (Nuclear). The Graduate School of Aerospace Engineering administers the Master of Engineering (Aerospace) degree program.

The general requirements for the degrees listed above are: (1) a minimum of thirty credit hours of advanced technical course work in the specific field or in related subjects, (2) a minimum of three credit hours (included in the above) of engineering design experience involving individual effort and formal report, and (3) a minimum grade point average of 2.5 and a minimum final grade of C minus for all courses counting toward the degree.

There are no residence requirements, although all course work must, in general, be completed under Cornell University staff instruction. The degree requirements must normally be completed within a period of four calendar years.



A graduate of Cornell University who holds a Bachelor of Engineering degree may be granted up to fifteen hours credit for advanced courses taken during his fifth undergraduate year, provided he enters the Master of Engineering program not later than the fall term following the sixth anniversary of his receiving the Bachelor of Engineering degree.

The *Announcement of the College of Engineering and Graduate Study in Engineering and Applied Sciences* should be consulted for further details on the various professional Master's degree programs.

## English

**Master of Fine Arts [M.F.A.].** The degree of Master of Fine Arts in creative writing is designed to prepare candidates for careers in professional writing or in the teaching of creative writing. The program is administered by a specially appointed committee of the Department of English, acting as a division of the Graduate School.

## Food Science and Technology

**Master of Food Science [M.F.S.].** This program is designed for students who hold a four-year engineering degree and want preparation for work in the food industry. Further information may be obtained from Professor Robert C. Baker, Rice Hall.

## Industrial and Labor Relations

**Master of Industrial and Labor Relations [M.I.L.R.].** The four-semester program leading to this degree provides a basic course of graduate study for those with professional interests in industrial and labor relations and further provides limited opportunities for specialized professional study where broad competence has been established. This degree is administered by the Division of Industrial and Labor Relations of the Graduate School. Students possessing a law degree may be eligible for a two-semester M.I.L.R. program. More information may be obtained by writing to the Graduate Field Representative, School of Industrial and Labor Relations, Ives Hall.

## Law

The following two degrees are administered by the Division of Law of the Graduate School. The *Announcement of the Law School* should be consulted for a complete description of the program and requirements.

**Master of Laws [LL.M.].** This degree is intended primarily for the student who desires to increase his knowledge of the law by working in a specialized field.

**Doctor of the Science of Law [J.S.D.].** This degree is intended primarily for the student who desires to become a proficient scholar by original investigation into the functions, administration, history, and progress of law.

## Music

These two degrees are appropriate for mature composers who seek further professional training as well as knowledge of the other arts and humanities, both to enrich their creative perspectives and to prepare them for the teaching of composition and theory at the university level.

**Master of Fine Arts [M.F.A.], Doctor of Musical Arts [D.M.A.].** The degrees are administered by the Department of Music, acting as a division of the Graduate School for this purpose. More information may be obtained from Professor Robert M. Palmer, 218 Lincoln Hall.

## Nutrition

**Master of Nutritional Science [M.N.S.].** This program emphasizes fundamental study in the basic biological sciences that can lead to specialization in such areas as nutritional biochemistry, human and clinical nutrition, experimental or animal nutrition, and public health and international nutrition. The program is open to students who have had no previous course work in nutrition. For candidates interested in the biological sciences, the program serves as a valuable preliminary for graduate study for the Ph.D. degree in such areas as biochemistry and physiology, as well as human or animal nutrition. This degree is administered by the faculty of the Graduate School of Nutrition acting as a division of the Graduate School. The *Announcement of the Graduate School of Nutrition* should be consulted, and more information may be obtained by writing to Secretary, Graduate School of Nutrition, Savage Hall.

## Theatre Arts

**Master of Fine Arts [M.F.A.].** The degree of Master of Fine Arts in theatre arts is intended for students who wish to increase their professional competence as actors or directors through a studio-oriented program. It is administered by the Department of Theatre Arts, acting as a division of the Graduate School for this purpose.

## Veterinary Medicine

**Doctor of Science in Veterinary Medicine [D.Sc. in V.M.].** This degree is characterized by a professional rather than a general research objective, and it is designed especially for experienced persons in the basic and clinical sciences who need more specific, advanced, scientific, and professional knowledge in order to equip themselves for careers in teaching and research. This degree is administered by the Division of Veterinary Medicine of the Graduate School.

## Graduate School of Medical Sciences

The Graduate School of Medical Sciences has the full responsibility for administrative matters related to

## 18 Research Facilities

the advanced general degrees granted for study in residence at the New York City campus of Cornell University. The general degrees of Ph.D. and M.S. are awarded in the fields of biochemistry, biological structure, biology, biomathematics, biophysics, genetics, microbiology, neurobiology and behavior, pathology, pharmacology, and physiology. (See p. 57).

The facilities for graduate work at the Graduate School of Medical Sciences include the lecture rooms, student laboratories, library, and research facilities of the Medical College and of the Sloan-Kettering Division. The special facilities and experienced investigators of the Sloan-Kettering Division offer ample opportunity for advanced graduate work in the basic science aspects of research related to cancer and allied diseases.

Predocctoral fellowships and teaching fellowships and research assistantships are available. Information on financial assistance and the entire program of the Graduate School of Medical Sciences is given in the *Announcement of the Graduate School of Medical Sciences*, which may be obtained from the Graduate School of Medical Sciences, Cornell University Medical College, 1300 York Avenue, New York 10021.

### Special Resources for Research and Advanced Study

The descriptions below are limited to major general facilities available to graduate students. Other substantial collections and facilities, in many instances unique, have been assembled for the use of graduate students. Although the facilities cannot be described adequately in this *Announcement*, some of them are mentioned in the statements given under the Fields of Instruction.

### Cornell University Libraries

The University's libraries offer support for graduate studies at several levels. They provide basic readings in virtually all subjects, collateral studies for classroom and seminar instruction, and highly specialized materials for advanced students. The total number of volumes at Cornell is now more than 3,600,000 and that figure increases by about 200,000 each year. An unusually rich collection of reference works, both modern and antiquarian, expedites both daily study and dissertational research. About 50,000 journal and periodical titles are available, most of them in complete runs, some of them in multiple copies, all of them immediately available. Special services are maintained for maps, microtexts, documents, newspapers, and other such collections.

Though there are many college, school, and department libraries on the campus, it is Olin Library, designed primarily as a research library, which becomes the most familiar to graduate students. Completed in 1961, it is designed to offer easy access to the book stacks, card catalogs, and photocopying facilities; it also provides a lounge area for graduate students and faculty. A graduate student may apply for the use of a carrel in order to facilitate completion

of his dissertation. Olin Library is open during the term from 8:00 a.m. to 12:00 midnight weekdays, and from 1 p.m. to 12:00 midnight Sundays.

Within Olin are a number of special collections likely to be of particular interest to advanced students of the social sciences and the humanities. The Department of Rare Books houses several distinguished collections, among them books and manuscripts relating to Dante, Petrarch, Wordsworth, Joyce, Shaw, and other literary figures. The Noyes Collection is rich in American historical documents, especially those pertaining to Lincoln and the Civil War. Students in the social sciences will also find extraordinarily interesting manuscripts and books in the collections of slavery and abolition, of witchcraft, of the French Revolution, and of the life and times of Lafayette. Long familiar to professional scholars are the Wason Collection on China, Japan, and Southeast Asia, and the Old Icelandic Collection. The History of Science Collections include the Adelmann Library of Embryology and Anatomy, and the library of the French scientist, Lavoisier. The Collection of Regional History and University Archives is a manuscript depository with total holdings of more than 20,000,000 items. These manuscripts relate to all aspects of the economic, political, and social history of this region and the areas historically connected with it. In addition to the collections in Olin Library, many of the college and department libraries also contain materials unique in their fields. Curators and reference librarians are available for counsel concerning the availability and use of research materials.

In addition to Olin Library, the Cornell University library system comprises Uris Library, an open-stack library for undergraduates; the Albert R. Mann Library of Agriculture and Life Sciences and Human Ecology; and the libraries of the following colleges, schools, and departments: Fine Arts, Business and Public Administration, Engineering, Hotel Administration, Industrial and Labor Relations, Law, Medicine (in New York City), Veterinary Medicine, Entomology, Mathematics, Music, and Physical Sciences. Added to these are the libraries of academic divisions and departments, together with those of the Agricultural Experiment Station at Geneva, New York.

### International Studies Programs

Cornell's approach to international studies is distinctive. There is no separate school or department of international studies with its own faculty and degree program. Rather, the variety of interests of the broad range of colleges and schools at Cornell and the diverse array of their departmental offerings form the foundation for strength in this area.

Students at Cornell have extensive opportunities to specialize in international studies at both the graduate and undergraduate levels. There are more than twenty formal programs of teaching and research on specific world regions or problem areas.

Undergraduates and graduate students may develop majors or minors in various aspects of international studies through the different colleges, schools, and

departments in which they are enrolled and through participation in the various programs. Many students with majors in other disciplines take courses in aspects of international and comparative studies that relate to and complement their majors. In addition, faculty members frequently provide special opportunities for both graduates and undergraduates to do work in particular facets of international studies.

### **Center for International Studies**

The Center for International Studies supports and coordinates the University's programs of international and comparative studies. By serving as a focal point for ideas, information, and advice about the University's wide range of international offerings, the Center contributes to their further development. The Center places particular emphasis on strengthening inquiry into issues which cut across professional and area concerns, and to providing a continuing source of innovation and experimentation in international studies. Through its constituent programs the Center promotes interdisciplinary teaching and research to supplement work done within the regular departments and Fields.

The Center engages in a range of other activities. It conducts the Undergraduate Interdisciplinary Program, offering one course per semester designed to bring the insights of several disciplines to bear on major international problems. It frequently appoints visiting faculty and currently shares several permanent appointments with various departments. It sponsors lectures and seminars and brings distinguished visitors to Cornell to participate in conferences devoted to problems of international significance. It provides information on legislation of concern to the international studies community at Cornell, and keeps abreast of the possibilities for financial support for international studies. It publishes the *International Studies Newsletter*, and an annual report of international studies at Cornell.

The Center sponsors a program of small grants (up to \$500) for research of international or comparative significance, awarded competitively to graduate students in the fall and spring. Further information may be obtained from the Center for International Studies, Social Sciences Building.

### **China Program**

The China Program provides comprehensive graduate-level training and sponsors a wide range of research. Graduate students in the Program take a major in anthropology, economics, government, history, history of art, linguistics, or literature. Early mastery of the Chinese language sufficient to permit use of Chinese sources in courses and seminars and in research is expected. NDFL Title VI fellowships and London-Cornell Field Research Grants are available to some students in the Program.

The focus of much of the research and teaching in the Program is the society, polity, economy, culture, and arts of traditional and contemporary China. Research supported by the China Program includes: Chinese economic development, center-regional relationships in traditional and modern China; Japanese and Chinese linguistics; Southern Chinese

and Sino-Tibetan dialects; contemporary China's international relations; classical and early modern Chinese and Japanese literature; the religions and societies of Japan and China; ancient and contemporary Chinese relations with Southeast Asia; and cultural-religious practices of the China/Southeast Asia border regions.

Additional information on the Program and the various fellowships and awards may be obtained by writing to the Director, China Program, 140 Social Sciences Building.

### **European Studies Committee**

European studies at Cornell are coordinated by the European Studies Committee of the Center for International Studies. Limited support for graduate student research is available, but graduate study programs are supervised by individual faculty members and administered by the Fields with which they are associated. Further information may be obtained from the Center for International Studies, Social Sciences Building.

### **International Agriculture Program**

Cornell University provides unusual scope and facilities for graduate-level study and research concerning development of the critical agricultural sector of newly developing nations. An integrated program of research and graduate training in the various biological, physical, and social sciences fields which are relevant to agricultural development constitutes a minor in the Field of International Agricultural Development. The student may take courses which help him apply his knowledge to the special conditions of newly developing nations, consult with experienced faculty members in regard to such application, and pursue a dissertation research project relevant to the special problems of newly developing countries. In much of this work the program in agriculture draws upon the strong international programs in other colleges of the University, including the area study programs and the varied offerings in modern languages.

Additional information may be obtained by writing to Professor K.L. Turk, Director, International Agricultural Program, 102 Roberts Hall.

### **International Legal Studies Program**

The Cornell Law School offers a program of concentrated study in international legal subjects. The full program is ordinarily pursued by J.D. candidates in their second and third years of regular law study, but all the courses in the Field are open to graduate students in law. Some of the courses are offered by visiting faculty members who come to the Law School under its program for distinguished foreign professors. A number of foreign scholars and students also come to Cornell for research and study in the comparative and international law fields. Other activities of the International Legal Studies Program have included faculty seminars in comparative law, summer conferences in public international law, and a program of speakers and seminars open to students. In addition, the Law School sponsors a

## 20 Research Facilities

small number of fellowships for foreign students to pursue graduate work in law.

For more detailed information, see the *Announcement of the Law School* and the current annual report of the Center for International Studies, or write to Professor John J. Barcelo, Chairman, Graduate Study Committee, Cornell Law School.

### International Population

At the graduate level, the International Population Program stresses the relation of social and cultural factors affecting fertility, mortality, migration, and urbanization in various parts of the world. Teaching in the Program also includes demographic techniques and theory, family planning, ecology, population policy, and health and medicine. A Ph.D. candidate can major or minor in demography-ecology. An M.A. candidate in the Program usually minors in demography-ecology and majors in general sociology. Admission as a Ph.D. major in demography-ecology or as an M.A. major in general sociology, minoring in demography-ecology, is available to students in the graduate Field of Sociology. Students from most other graduate Fields may elect a minor within the Program. Further information may be obtained from the International Population Program, Room 370, Social Sciences Building.

### International Science and Technology

This new area of study at Cornell, coordinated by a committee of social scientists and natural scientists, focuses on cross-national flows of scientific and technological information and manpower, both between the developed and the developing countries and among more industrialized countries. Several new courses dealing specifically with these flows of science and technology and with problems of science policy and organization are now being taught at Cornell, and through the Program on Policies for Science and Technology in Developing Nations Cornell is becoming a center of expertise in this field. No formal major or minor is available, but several academic fields have one or more faculty members each who participate in the program. Thus, a Ph.D. candidate working with his Special Committee can receive considerable academic support to study and do research in this area. Further information may be obtained from the Program on Policies for Science and Technology in Developing Nations, Room 180, Social Sciences Building.

### Latin American Studies Program

Resources available at Cornell to the scholar interested in Latin American studies include formal course work, ample library facilities, and widely based research networks developed by the faculty. The work of the faculty members involved is characterized by diversity of interest and strengths in particular areas. There is diversity in the particular countries studied—some aspect of virtually every Latin American country has been examined by at least one member of the Program. The interdisciplinary nature of the Program means that research tends to be problem-oriented, with the application of relevant data from various fields.

Building on some twenty years' experience in the Andean region, Program members are currently involved there in research which includes the disciplinary perspectives of sociology, anthropology, archaeology, economics, and linguistics. In addition, Cornell helped to establish, and presently participates in, the Northeast Consortium for Andean Studies, which improves and develops cooperative efforts among its members (universities in the Northeastern United States) in the field of Andean studies.

Investigation of the unique experience of Brazil is currently being carried out by a number of researchers at Cornell in the fields of sociology, anthropology, economics, history, and agriculture.

Besides these geographical concentrations, research is underway on particular problems characteristic of developing nations: the processes and consequences of rapid agricultural development, urbanization, high population growth rates, family planning, and the increased United States presence.

Graduate students are encouraged to join with faculty members in their current projects and to contribute to the expansion of knowledge about Latin America through their own research efforts. Cornell students have been successful in obtaining funds from outside sources such as the Foreign Area Training Fellowship Program, the Fletcher School of Law and Diplomacy, Fulbright-Hays, the Doherty Foundation, and the Organization of American States; in addition, the Program has supported a number of students in thesis field research activities.

Additional information may be obtained by writing to Tom E. Davis, Director, Latin American Studies Program, 190 Social Sciences Building.

### Program on Participation and Labor-Managed Systems

In the world today, in different forms and in varying degrees, we witness a tendency for workers to assume control and management of the enterprises in which they are employed. The Yugoslav economy is the best known example, but there are many other instances.

As a result, the Program on Participation and Labor-Managed Systems was established to conduct theoretical and empirical research in the area of participation. Both faculty and students are eligible for research support. Besides research, two to three courses a year are offered in the area in the Department of Economics. There are guest lecturers and an occasional course in cooperation with other departments.

The Department of Economics offers a Ph.D. major and a minor in the area of participation. The faculty taking part are Tom E. Davis, Dennis C. Mueller, George J. Staller, and Jaroslav Vanek, who is also the Director of the Program.

### Peace Studies Program

The Peace Studies Program sponsors teaching and research on the moderation or avoidance of war, and on the political, economic, technical, and social implications of progress towards peace. In graduate



teaching and research, the Program emphasizes an interdisciplinary approach involving social scientists, natural scientists, engineers, and lawyers. The graduate student can participate by choosing one or more faculty members associated with the Peace Studies Program to serve on his Special Committee. Further information may be obtained from the Director, Professor George Quester, Center for International Studies, Social Sciences Building.

### Rural Development

Although there is no formal major or minor in rural development, interested students can participate by selecting for their Special Committees faculty members interested in rural development. The Rural Development Committee brings together Cornell's strengths in this interdisciplinary area. Further information may be obtained from the committee chairman, Professor Norman Uphoff, Center for International Studies, Social Sciences Building.

### South Asia Program

The South Asia Program encompasses the study of Bhutan, Ceylon, India, Nepal, Pakistan, and Sikkim. Qualified graduate students interested in specializing in the study of South Asia can minor in the Field of Asian Studies or in South Asian linguistics. The doctoral candidate must achieve a reading knowledge of Hindi or some other important language of South Asia. Doctoral dissertations of students in the South Asia Program are normally based on research done in India, Pakistan, Ceylon, or Nepal. At least one member of the South Asia Program faculty has been in South Asia for each of the past several years. Cornell is a charter member of the American Institute of Indian Studies, organized to facilitate study and research in India, and maintains close links with a number of South Asian research agencies, programs, and institutions of higher learning whose staff members have provided valuable assistance to Cornell students. Graduate students may become associated with Cornell-sponsored research in South Asia or carry on independent research abroad.

Current research studies include a long-term research project primarily concerned with agricultural development and its ramifications in India and research projects on the palaeo-anthropology of the subcontinent of India and Ceylon, as well as religion and cultural change. Other studies include rural development and communications. Several studies are being conducted on languages of the area, including a special study of the Sinhalese language and linguistic problems of Ceylon, and research in Hindi, Tamil, and Telugu (important languages of India). With Ford Foundation support, Cornell has assisted Delhi University to become a major center in the Field of Linguistics and has an on-going interest in such applied projects.

National Defense Education Act Title VI (NDFL) Fellowships are open to incoming graduate students. Since all degrees are given with majors in disciplinary fields rather than in regional studies, students should apply directly to the graduate field of their interest. For other information on the South Asia

Program, write to the Director, South Asia Program, 130A Social Sciences Building.

### Southeast Asia Program

The Southeast Asia Program possesses substantial facilities for graduate study and research and provides exceptional opportunities for work on all of Southeast Asia in various disciplines of the humanities, social sciences, and some natural sciences. Instruction in the major languages of the area is an integral part of the graduate training of the Program, and special intensive instruction in these languages is available during most summer sessions. Entering graduate students are encouraged to begin language studies during the summer preceding registration in the Graduate School.

Possible sources of financial aid include Southeast Asia Program Fellowships; National Defense Foreign Language (NDEA Title VI) Fellowships; and, for advanced Ph.D. candidates, London-Cornell Field Research Grants and Fulbright-Hays funded Doctoral Dissertation Research Fellowships. Information about Foreign Area Training Fellowships, administered by the Social Science Research Council, may be obtained by writing to the Foreign Area Fellowships Program, 110 East 59th Street, New York, N.Y. 10022.

Additional information on the Program and the various fellowships and awards may be obtained by writing to the Director, Southeast Asia Program, 120 Social Sciences Building.

### Soviet Studies

The University offers a number of courses and seminars on the Soviet Union as well as pre-1917 Russia. Instead of a separate area program, graduate students have a choice of majors and minors in the established Fields of the Graduate School. Some of the subjects focus on area specialization: Russian history, Russian literature, Slavic linguistics. Other subjects combine area specialization with a nonarea framework: comparative government, economic planning, regional planning, social psychology. Graduate students pursuing Soviet studies in any of these subjects are expected to attain proficiency in the Russian language either before or soon after entering the Graduate School.

The Committee on Soviet Studies coordinates the University's academic activities related to Russia and sponsors a colloquium for faculty members and graduate students in Soviet studies. In the Soviet Studies Graduate Study in the John M. Olin Library, major reference works and key current periodicals from and about the U.S.S.R. are brought together. Inquiries about fellowships and other aspects of Soviet studies should be addressed to Professor Myron Rush, Chairman, Committee on Soviet Studies, Social Sciences Building.

### Other Programs and Studies

#### Africana Studies and Research Center

The Africana Studies and Research Center was created in an effort to remedy the deficiencies in the higher education of Blacks. The basic concept of the

## 22 Research Facilities

Center is recognition of the responsibility of the Black educator not only to pioneer and develop Black studies as a vital educational field, but also to train people who will be intellectually and technically competent.

The graduate program is designed to afford as much opportunity as possible for structuring curricula suited to the student's individual aspirations. To facilitate these plans, the Center is developing an Africana library with extensive coverage.

Additional information may be obtained from the Africana Studies and Research Center, 310 Triphammer Road, Ithaca, New York, 14850.

### American Studies

Although there is no formal program leading to a degree in American studies, candidates for the doctorate in English and history will find ample opportunity to do interdisciplinary work in conjunction with a major in American studies within their Field. There are members of the staff in both Fields who are professionally trained and currently active in the study of the interrelationships of American intellectual, literary, and social history, so that a student concentrating in American literature or American history may take advantage of the freedom permitted by Graduate School regulations and, in collaboration with his Special Committee, readily build an individual doctoral program that systematically embraces more than a single discipline. Inquiries concerning opportunities in this area should be addressed to Professor S. Cushing Strout, Chairman, American Studies Committee, Goldwin Smith Hall.

### Brookhaven National Laboratory

Cornell is one of nine eastern universities participating in Associated Universities, Inc. (AUI). Operating under contract with the Atomic Energy Commission, this corporation has the responsibility for the management of Brookhaven National Laboratory. The Laboratory provides unusual research facilities for studies in biology, chemistry, applied mathematics, medicine, physics, high-energy particle physics, and reactor and nuclear engineering.

Graduate students may participate in research at Brookhaven by association with Cornell staff members who are engaged in research at the Laboratory. The Laboratory also offers temporary summer appointments to a limited number of selected graduate and undergraduate students in science or engineering.

### Center for Environmental Quality Management

The Center for Environmental Quality Management brings together the faculties of the Cornell Medical College in New York and the various colleges and schools in Ithaca to study the manifold questions of environmental health in both urban and rural settings.

Present approaches to the modification and control of the environment have concentrated on limited objectives such as air quality control, disease control, pest control, food sanitation, and occupational health. Their success has been limited because they have

been unable to take into account the interdependence of environmental health problems. Scientific management through systems analysis has begun to make it possible to consider these multiple relationships within the framework of common objectives and subject to predetermined constraints. It provides mechanisms by which various innovations can be examined in terms of their short- and long-term effects upon the environment. Such an approach provides rational bases for establishing environmental quality goals and for the allocation of scarce resources to achieve these goals.

The Center is frequently able to provide predoctoral and postdoctoral fellowships for students interested in pursuing research topics in environmental health. Further information may be obtained from Professor Walter R. Lynn, Director, Center for Environmental Quality Management, 302 Hollister Hall.

### Center for Improvement of Undergraduate Education

The Center for Improvement of Undergraduate Education endeavors to improve the quality of university-level instruction by creating an atmosphere for stimulating educational innovation within the Cornell community. Faculty and students from all disciplines use the Center as a focal point for projects involving educational research and improvement in instruction. The Center is concerned with developing methodology for observation and evaluation of teaching effectiveness, and serves as a resource bank and an instructional equipment demonstration laboratory. The Center sponsors programs involving teacher training and the preparation of teaching materials.

The Center provides predoctoral and postdoctoral training through research assistantships, training grants, and postdoctoral fellowships. For information write to Professor James B. Maas, Director, Center for Improvement of Undergraduate Education, Rand Hall.

### The Center for Urban Development Research

The Center for Urban Development Research is an interdisciplinary facility established to stimulate, develop, and support research, training, and service programs in the fields of urban and regional studies.

The Center functions through an advisory board organized on a multidisciplinary basis representative of the departments and colleges offering instruction in urban and regional subjects. Administrative support and facilities are provided for faculty members and graduate students who are engaged in research activities. Several service and training programs are under Center auspices. These include: basic and applied research which focuses upon the managerial and programmatic aspects of urban and regional development; training programs in regional science research and in comprehensive health planning; and service programs in urban planning and planning extension.

Through administration of the graduate Fields of Regional Science and Urban Studies, the Center also provides a continuing forum for inquiry and study

in these interdisciplinary Fields. Students may select a major in Regional Science and a minor in either Urban Studies or Regional Science. The magnitude of course offerings and the flexibility of graduate requirements allows a large measure of latitude in selecting courses of study from the regular offerings of various departments of the University. Opportunities to participate in research activities of the Center are available to a selected number of graduate students within the limitations of their field of study and the nature of ongoing research projects.

Further information may be obtained from Professor Barclay G. Jones, Acting Director, Center for Urban Development Research, 726 University Avenue.

### **Center for Radiophysics and Space Research**

The Center for Radiophysics and Space Research unites research and graduate education carried on by several academic departments in the space sciences. It furnishes administrative support and provides facilities for faculty members and graduate assistants who are engaged in space research activities. It offers opportunity for graduate students to undertake thesis work in astronomy and astrophysics, atmospheric and ionospheric radio investigations, radar and radio astronomy, or space vehicle instrumentation. A student's major professor can be chosen from the following Fields in the Graduate School: Aerospace Engineering, Applied Physics, Astronomy and Space Sciences, Chemistry, Electrical Engineering, Physics.

The facilities of the Center include, on the Cornell campus, the Lunar Surface and Electronics Laboratory, the Infrared Laboratory, and the Laboratory for Planetary Studies; and the Radio Astronomy and Ionospheric Laboratories which are close to Ithaca. Students may also be associated with the Cornell-operated National Astronomy and Ionosphere Center (NAIC) which operates the world's largest radar-radio telescope at Arecibo, Puerto Rico. At Arecibo an extremely sensitive radio telescope and unusually powerful space radar are available for use by qualified graduate students who often conduct their thesis research while resident there. In addition, there are facilities available at Sydney University, Australia. (See below).

### **Cornell-Sydney University Astronomy Center**

The Center is an interuniversity organization designed to create a larger pool of facilities and skills for research in astronomy and related fields than would be available to either university separately. Graduate students can be interchanged between the two institutions whenever appropriate for the research work. Each university recognizes research supervision extended by the other, and the time spent by a student on thesis work in the sister university can be accepted toward residence requirements, provided that the home research supervisor approves and that the home university bylaws are not contravened.

The facilities available through the Center, in addition to those of Cornell's Center for Radiophysics and Space Research, are the one-mile by one-mile Mills Cross situated at Hoskintown, New South Wales; the stellar intensity interferometer situated at Narrabri,

New South Wales; the Criss-Cross, the Shain Cross, and Mills Cross situated at Fleurs, New South Wales; the Wills Plasma Physics Department, the Basser Computing Department, the Falkner Nuclear Department and the facilities of the cosmic ray group at the University of Sydney. The Center includes H. Messel, R. Hanbury Brown, W.N. Christiansen, C.B.A. McCusker, and B.Y. Mills all from the University of Sydney faculty.

Further information can be obtained from Professor Thomas Gold, Joint Director, Cornell-Sydney University Astronomy Center, Space Sciences Building, Cornell University.

### **Developmental Studies**

Specialization in this area normally involves participation in a program jointly sponsored by the Field of Human Development and Family Studies and the Field of Psychology. Interested students should apply to one of these Fields. Training in research skills in both Fields is recommended. Current research interests of the faculty include development of language, perception, thinking, intellectual development in natural settings, conceptual and affective behavior in infancy, cognitive socialization, and biological maturation.

### **Division of Biological Sciences**

The Division of Biological Sciences was established in 1964 to bring together into a single administrative unit a number of investigators and teachers representing a broad spectrum of interests in basic biology. The Division has the primary responsibility for the promotion of research in basic biology, and its members, as part of the Graduate School faculty, teach in appropriate Fields. The following subject areas are represented by separate sections of the Division: biochemistry and molecular biology; ecology and systematics; genetics, development, and physiology; microbiology; and neurobiology and behavior. A number of fellowships, assistantships, and traineeships are available through the Division. For further information, write to the appropriate field representative.

### **Materials Science Center**

The Materials Science Center (MSC) is an interdisciplinary laboratory created to promote research and graduate student training in all phases of the science of materials. The subjects of study represented in the MSC program are applied physics, chemistry, electrical engineering, materials engineering, materials science, mechanics, metallurgy, and physics.

For a student who chooses to specialize in one specific area, the MSC program could help by providing new equipment, financial assistance through research assistantships, or, in some cases, the help of a technician to carry out routine measurements. If the student wishes to follow a program of considerably more breadth than usual in his research training, the MSC program provides an additional advantage. Several central facilities have been set up where more specialized apparatus such as crystal-growing furnaces, x-ray and metallography



## 24 Research Facilities

equipment, electron microscopes, etc., are available. Expert advice on use of the equipment and the interpretation of the results is also available.

Further information may be obtained from the Director, 627 Clark Hall.

### Laboratory for Plasma Studies

Established in 1966, the Laboratory for Plasma Studies at Cornell enables students and faculty members to deal with plasma, electron, and laser physics on a unique, interdisciplinary basis. In the future, plasmas will provide power for cities and spacecraft, will help to explain the composition of the universe, and may unlock the energy resources of the sea. The unified approach to plasma studies enables the University to give the best counsel to graduate students who want to combine their knowledge of some field of science or engineering with work in plasma studies. A program now exists whereby graduate study in plasma physics is offered to students in aerospace engineering, applied physics, chemistry, electrical engineering, mechanical engineering, and physics. Graduate research assistantships and positions as postdoctoral research associates are available through the Laboratory.

For further information, write to Professor Peter L. Auer, Director, Laboratory for Plasma Studies, Upson Hall.

### Program on Science, Technology, and Society

The purpose of the interdisciplinary Program on Science, Technology, and Society is to stimulate and support teaching and research on the interaction of science and technology with contemporary society. The Program has initiated a number of research and teaching efforts and also plays a role in providing coherence and support for related activities already under way at the University.

The topics of concern to the Program are the following: science, technology and national defense; technology assessment; world population and food resources; legal and moral implications of modern biology and medicine; national policy for the development of science; sociology of science and technology; and the ecological impact of developing technology.

The mechanisms for studying these problems vary and include courses, seminars, short workshops, and summer studies, as well as individual research programs. The Program welcomes the participation of students and faculty from all colleges and schools of the University. A few graduate research assistantships are available and may be applied for by any student with an appropriate thesis research program. Information on these and a list of relevant courses in all parts of the University may be obtained from the Program office, 628 Clark Hall (telephone: 607-256-3810).

### Society for the Humanities

The Society awards three categories of fellowships for research in the humanities—Senior Fellowships, Faculty Fellowships, and Junior Postdoctoral Fellowships. The Fellows offer informal seminars

intended to be off the beaten track. Details about the seminars are circulated to interested departments.

Membership in the Society's seminars is open, after a personal interview with the Fellow, to graduate students and suitably qualified undergraduates. All seminars are held in the Society's house at 308 Wait Avenue. Students wishing to enroll in these seminars should contact the Society (256-4086) early in the first week of the term to arrange an interview. Students wishing credit for the course must formally register for it in their own college.

The Fellows for 1972-73 are Angus C. Graham (University of London), *The Translation of Chinese Poetry and Chinese Philosophy*; Hubert Damisch (Ecole des Hautes Etudes, Paris), *The Theory of Art and Practices of Signification*; David O. Edge (University of Edinburgh), *Technological Metaphor*; Robert E. Kaske (Cornell University), *Principles of Biblical Exegesis in Medieval Literature*; David B. Lyons (Cornell University), *Moral Skepticism and Moral Knowledge*; Fu-mei Chang Chen (Harvard Law School), *Law in Traditional Chinese Society and Law and Society in Imperial China*; Christopher Bruell (Boston College), *The Philosophy of Plato*; Francesco del Punta (Oxford University), *William Ockham's Commentary on Aristotle's Sophistical Refutations and Truth and Meaning of Propositions in Fourteenth Century Logic*.

### Statistics Center

The methods of statistics find important applications in many diverse fields of research. It is therefore necessary that (1) subject-matter specialists be able to obtain assistance in using or developing statistical theory, (2) students who intend to do research work in a particular field which makes extensive use of statistical methods receive adequate training in statistics, and (3) individuals be trained as statisticians. The staff members of the various schools and colleges of Cornell University who are interested in the development and application of statistical methods are associated with the Cornell Statistics Center, which provides individuals, projects, and departments with assistance and guidance concerning the statistical aspects of research and training programs.

The acting director of the Center is Professor Philip J. McCarthy, Ives Hall.

### Center for Water Resources and Marine Sciences

The Center is an interdisciplinary organization, serving the entire University at the graduate-study and research level, intended to promote and coordinate a comprehensive program in water resources planning, development, and management in relationship to land and other environmental concerns. Its responsibilities are to undertake and support water resources research in engineering, in the physical, biological, and social sciences, and in the humanities; to encourage and contribute to graduate studies in water resources; to coordinate relevant research and training activities; to encourage new combinations of disciplines in research and training which can be brought to bear on water resources problems; to disseminate the results of research; and

to develop and operate central facilities for research and training. See also the Field of Water Resources.

Correspondence concerning the Center should be directed to Professor L.B. Dworsky, Director, Center for Water Resources and Marine Sciences, Hollister Hall.

## Special Facilities and Service Organizations

### Military Science and Aerospace Studies

The advanced courses in military science (Army ROTC) and aerospace studies (Air Force ROTC) are open to graduate students who have satisfactorily completed a basic course in ROTC or who enroll in a two-year ROTC program. Successful completion of a two-year advanced ROTC course will qualify a graduate student for appointment as a second lieutenant in the United States Army or Air Force, or as a second lieutenant in the Regular Army or Air Force. Interested graduate students should consult the *Announcement of Officer Education* and apply to Professor of Military Science, or Professor of Aerospace Studies (ROTC), Barton Hall.

### New York State Agricultural Experiment Station at Geneva

The New York State Agricultural Experiment Station, established in 1880, is located at Geneva, fifty miles from Ithaca, and has been under the administration of Cornell University since 1923.

Professors on the Geneva staff are eligible to serve as members of the Special Committees of graduate students along with professors on the Ithaca campus. Normally, the graduate training provided at Geneva consists of research experience and supervision of the student's work on a thesis problem in chemistry, economic entomology, food technology, microbiology, plant pathology, pomology, seed investigations, and vegetable crops. Students who plan to do part of their graduate work at Geneva should correspond with their major advisers or with the dean of the Graduate School concerning pertinent regulations. Ample facilities are available for graduate research under laboratory, greenhouse, pilot-plant, insectary, orchard, and other field conditions.

For further information, address the director, Professor D.W. Barton, New York State Agricultural Experiment Station, Geneva, New York 14456.

### Office of Computer Services

The principal computing facility at Cornell is an IBM 360 Model 65 located at Langmuir Laboratory in Cornell's Research Park. The 360/65 system is equipped for remote access of several kinds and designed so that very few users find it necessary to visit Langmuir.

The primary terminals are high-speed reader-printers located in Upson, Clark, and Warren Halls. These remote job-entry and delivery devices permit convenient access, job turnaround-time in terms of minutes, and the use of on-line files. Each of these terminals is the core of a small computing center, with auxiliary equipment, consulting assistance, reference material, and work space.

In addition to these high-speed terminals, typewriter terminals can be used to access the 360/65 system interactively. An interactive facility located in the Social Sciences Building provides access to typewriter terminals as well as consulting and programming assistance in interactive systems. Typewriter terminals are available to individual projects that require interactive capability.

The 360/65 computing system is busy, but not saturated, and use by graduate students is encouraged. For further information about the operation of the system and for consulting and programming assistance write to the Office of Computer Services, Langmuir Laboratory.

### University Press

Cornell University Press is the book-publishing division of the University. It publishes general and specialized nonfiction in all fields of interest as well as, occasionally, selected works of serious fiction, usually in translation. More than twenty-five percent of the approximately 800 titles now in print on the Press's list were written by members of the Cornell faculty; the others are the work of scholars from this country and abroad. The imprint of Comstock Publishing Associates, a division of the Press, is placed on certain books in the biological sciences. The Press is an academic activity of the University, and all books that carry its imprint have been approved for publication by the Press's Board of Editors, which consists of members of the University faculty.

### Visual Aids

The University owns and operates the Photo Science Studios, which create, or cooperate in creating, photographic studies and visual aids of all kinds.

# Fields of Instruction

## Humanities

**Architecture, Art, Chinese Literature, The Classics, Comparative Literature, English Language and Literature, Germanic Studies, History, History of Architecture and Urban Development, History of Art and Archaeology, Medieval Studies, Music, Philosophy, Romance Linguistics, Romance Studies, Semitic Studies, Slavic Studies, Theatre Arts**

## Architecture

### Field Representative

Charles W. Pearman, 129 Sibley Hall

### Major and Minor Subjects

Design (architectural design, urban design, regional design); Architectural Science (applied behavioral science, environmental technology, architectural structures, industrialized building, computer applications)

Graduate study in the Field of Architecture may be pursued in design leading to the Master of Architecture or in architectural science leading to the degree of Master of Science. Study in architectural history is offered in the Field of History of Architecture and Urban Development. There is a joint degree program with the Field of City and Regional Planning. Every applicant for graduate study is expected to select and identify in advance the program he intends to follow.

Foreign students whose undergraduate training has been completed outside the United States are admitted to provisional candidacy. They should plan to spend at least four terms in residence for the Master's degree.

### Design

Students who have satisfactorily completed an undergraduate professional degree in architecture or its equivalent at an approved institution may be admitted as candidates for the degree of Master of Architecture. Three areas of major concentration are offered: architectural design, urban design, and regional design. These areas are each sufficiently broad to verge on one another while focusing in general on the scale of problems suggested by the designation. It is assumed that each student will develop his elective program to reinforce and supplement the studio work.

Normally four terms of study are required, and the student should not anticipate completing his studies in less than

this time, although in special cases the requirements for the degree may be completed within a three-semester period.

The programs leading to the Master of Architecture degree are administered by Program Concentration Committees consisting of the Field representative and those faculty offering work in the area of concentration. The Special Committee includes two advisers in the area of major concentration and one adviser in the area of minor concentration. The thesis is directed by the Special Committee with an additional member at the student's option.

### Architectural Science

Students with undergraduate degrees in architecture, architectural engineering, behavioral science, or the various branches of engineering, are likely candidates for the graduate program in architectural science. Its objectives are (1) to afford an opportunity for students of architecture to expand their creative design potential by increasing their knowledge and understanding of environmental science and building technologies; (2) to provide a framework within which students graduating in related scientific technical disciplines can explore building science and technology related specifically to architecture; and (3) to provide a framework within which the student graduating in related behavioral science areas can explore the application of these disciplines in an architectural context.

Ordinarily four terms of residence will be required to complete the program of study, depending on the student's background and experience as they relate to his needs and interests.

Facilities include a well-equipped structural model laboratory and immediate access to the Cornell computing center (IBM 360).

### Faculty and Specializations

- T. W. Canfield: architectural technology, design
- R. W. Crump: environmental controls
- D. P. Greenberg: architectural technology, structural analysis and design, suspension structures, computer graphics, model analysis
- A. Kira: human engineering and psychological aspects of architecture
- A. Koetter: urban design, regional design, housing, building systems
- R. MacDougall: anthropology
- K. C. Parsons: urban design, land use, institutional planning, history of collegiate architecture

- C. W. Pearman: architectural design, urban design, regional design, housing, building systems  
 J. W. Reps: planning administration, history of city planning in the United States and Europe, development of urban America, design character of American cities  
 C. Rowe: history of Renaissance and modern architecture, urban design, architectural criticism, contemporary European and American architecture  
 F. W. Saul: structural steel and reinforced concrete building design, structural plastics and blast-resistant design  
 W. Seligmann: architectural design, urban design  
 J. P. Shaw: architectural design, urban design, regional design  
 R. Sherwood: urban design, housing  
 D. M. Simons: computer applications, architectural design  
 S. W. Stein: urban design, site planning, urban renewal, housing  
 O. M. Ungers: housing, urban design, regional design  
 J. A. Wells: urban design, housing, building systems

#### *Faculty for the M. Arch. Degree Only*

- M. Dennis: architectural design, urban design  
 D. Heerwagen: industrialized building, environmental control system, materials technology  
 K. Herdeg: architectural design, urban design  
 L. F. Hodgden: architectural design, theory and criticism  
 W. G. Lesnikowski: housing, building systems  
 A. Mackenzie: architectural design methods, urban design  
 E. Messick: visual communication systems  
 R. Sherwood: architectural design, urban design  
 D. Simons: architectural science, architectural design

## Art

### Field Representative

Steve Poleskie, B27 Franklin Hall

### Major and Minor Subjects

Graphic Arts, Painting, Sculpture

Applicants must have a Bachelor's degree or its equivalent and must clearly demonstrate professional promise in art by submission of a portfolio. Further information is available from the Field representative.

This Field offers only the degree of Master of Fine Arts. The M.F.A. Program requires four terms of residence and is intended for those who wish to complete their education as artists. Candidates must complete fifteen credit hours of courses in the history of art, either as graduate or as undergraduate students, and must take at least twelve hours of academic work outside the Department of Art.

The faculty is composed of practicing artists who teach rather than teachers who practice art. The entire resident faculty and the visiting critics are available to give criticism to graduate students.

The buildings which house the programs are open twenty-four hours a day; they are adjacent to the Fine Arts Library (61,000 volumes) and not far from the University's Andrew Dickson White Museum of Art.

A candidate in the program in painting or sculpture is required to present a one-man exhibition at the end of the third term. For painting students, the principal effort of the fourth term is a thesis painting demonstrating creative ability and technical proficiency. Graduate painting is under the direction of Professor Seley. Students work in separate studios in Franklin Hall. Graduate sculpture is under the direction of Professors Colby, Seley, and Squier. The sculpture program has its own building, a 45- by 180-foot converted foundry with 14-foot ceilings. Separate studios, complete gas- and arc-welding facilities, heavy

duty grinders, a drill press, a band saw, and a variety of portable power tools are provided. Graduate students in the graphic arts program study the various techniques, including relief, intaglio, lithography, and various photographic processes. Experiment and tradition, theory, history, and practice are part of the program. Graduate graphic arts is under the direction of Professors Singer and Poleskie. The program's facilities in Franklin Hall include etching presses, lithographic presses, proof presses, and a type shop.

### Faculty

J. E. Bosson, Jr., T. Burton, V. E. Colby, N. D. Daly, K. W. Evett, J. O. Mahoney, G. Pederson-Krag, S. Poleskie, S. Porter, J. Seley, A. Singer, J. L. Squier, P. Thompson

### Visiting Critic

F. Dzubas

## Chinese Literature

### Field Representative

Tsu-lin Mei, 154 Rockefeller Hall

### Major Subject

Chinese Literature

### Minor Subjects

Chinese Literature, East Asian Linguistics

At least two years of Chinese language study (including an introduction to classical Chinese) are required prior to admission. Preference is given to applicants who have worked in English or European literature. Candidates for the Ph.D. degree whose undergraduate education was in a Chinese university are normally expected to have taken a degree in English or European literature before admission.

A reading knowledge of Japanese is essential for the M.A. degree and, at a higher level of proficiency, for the Ph.D. degree. Reading knowledge of at least one European language is highly desirable.

A qualifying examination is given during the second semester of the first year. The candidate for the M.A. degree is expected to take five semester courses and write a thesis. An examination on the thesis is required for both the M.A. and the Ph.D. degrees.

Candidates for the Ph.D. degree are eligible for fellowships offered under the China Program.

### Faculty

N. C. Bodman, E. Jorden, J. McCoy, T. Mei, H. Shadick, E. Terasaki, K. M. Wong

## The Classics

### Field Representative

Frederick M. Ahl, 23 Goldwin Smith Hall

### Major Subjects

Ancient Philosophy, Classical Archaeology, Greek Language and Literature, Latin Language and Literature, Medieval and Renaissance Latin Literature

### Minor Subjects

Ancient History, Classical Rhetoric in the Original or Translation, Classics (when the major is in another Field), Indo-European Linguistics

Applications must include scores from the Graduate Record Examinations.



## 28 English Language and Literature

Candidates for the M.A. degree ordinarily spend two semesters attending seminars and/or studying with faculty guidance, present a special essay of about thirty pages, and pass a written test in translation from Greek and Latin authors and a general oral examination. They must also demonstrate proficiency in French or German. The final oral examination, based partly on the classical authors and partly on the special essay, may also serve as the qualifying examination for the Ph.D. degree.

In addition to seminars and other course work, the candidate is responsible for obtaining extensive knowledge of Greek and Latin authors on the official reading lists compiled by the Field. He must also demonstrate proficiency in a second modern language. Every candidate is expected to teach for two semesters. Students majoring in archaeology may have the opportunity to participate in excavations during the summer.

The Departments of Classics and of Philosophy cooperate in offering a program leading to a Ph.D. in the Field of Classics with ancient philosophy as the major subject. The course of study includes two courses in Plato and in the Pre-Socratics (one in the Department of Classics, one in the Department of Philosophy), two courses in Aristotle and/or the Hellenistic philosophers (similarly divided), and such other courses in the Departments of Classics and Philosophy as student and adviser decide.

Among awards available to incoming students are the Florence May Smith Fellowships with a stipend of \$2,000 plus tuition.

### Cornell Studies in Classical Philology

Since 1887, thirty-five volumes have appeared in the series. The volumes include grammatical, historical, and archaeological studies, as well as studies in classical literature and thought. The series continues to be published today.

### Faculty and Specializations

E. E. Adler: Augustan poetry  
F. M. Ahl: Roman epic and tragedy  
E. Asmis: Greek, Roman and Hellenistic philosophy  
K. M. Clinton: Greek epigraphy, Greek and Roman religion, Greek and Roman tragedy  
J. E. Coleman: classical archaeology  
J. Hutton: Greek anthology, Greek and Latin epic, Renaissance humanism  
G. M. Kirkwood: Greek and Roman theatre, Greek lyric poetry  
G. M. Messing: classical and Indo-European linguistics  
P. Moore: Roman historians, Silver Age prose  
P. Pucci: textual criticism, Greek theatre  
M. C. Stokes: Greek and Roman philosophy

## Comparative Literature

### Field Representative

William J. Kennedy, 156 Rockefeller Hall

### Major and Minor Subject

Comparative Literature

Applicants should be prepared to study three literatures (one of which may be English or American) in the original language. The Field requires scores of the Graduate Record Examinations Aptitude and Advanced Tests.

Normally, all candidates are admitted directly to the Ph.D. program; however, a candidate may be granted an M.A. after the admission to candidacy examination or he may take a Master's degree in one literature of his choice.

Specialization is possible in almost every major area from medieval to modern studies and in literary criticism and

theory. Students can spend some time in Europe and receive full graduate credit.

A qualifying examination is given during the first semester. The student's course of study is very flexible and is adapted to individual needs. In principle, the candidate may choose between two typical patterns of study, though combinations of the patterns are of course possible.

In Pattern I, his principal concentration is in one national literature and he minors in two others. English and American cannot be counted as separate literatures for this purpose. In the major, he is responsible for topics drawn from the whole history of that literature; in the two minors, for a restricted historical period.

In Pattern II, the student is still responsible for three literatures, but the three areas of concentration will be (1) a period or literary movement; (2) a genre, or an aspect of theory; and (3) at least one major writer.

### Faculty and Specializations

M. H. Abrams (English), E. A. Blackall (German), M. Carlson (theatre arts), H. Dieckmann (French and comparative literature), E. G. Fogel (English), G. Gibian (Russian), D. I. Grossvogel (French and comparative literature), W. W. Holdheim (French and comparative literature), R. E. Kaske (English), W. J. Kennedy (comparative literature), G. M. Kirkwood (classics), E. P. Morris (French), B. Pedersen (comparative literature), I. Rabinowitz (Hebrew), R. Roopnaraine (comparative literature), E. Rosenberg (English and comparative literature)

## English Language and Literature

### Field Representative

Phillip L. Marcus, 252 Goldwin Smith Hall

### Major and Minor Subjects

American Literature, American Studies, Creative Writing (cannot be the major for the Ph.D.), Dramatic Literature, English and American Literature, English Linguistics (minor only), English Poetry, The English Renaissance to 1660, The Nineteenth Century, Old and Middle English, Prose Fiction, The Restoration and Eighteenth Century, The Twentieth Century

### Admission

Applicants may request admission to either the Master of Arts program, the Master of Fine Arts program in creative writing, or the doctoral program. They are required except under unusual circumstances to submit Graduate Record Examinations scores (Aptitude and Advanced Tests) and should plan to take the Examinations by mid-December at the very latest. Applicants for admission to the M.F.A. program must submit samples of their writing to the Committee on the Creative Writing Program, Department of English, Goldwin Smith Hall. To guarantee fair consideration of any application, the application itself and all supporting documents should reach the Graduate School by January 15; February 1 is the absolute deadline for all applications, whether or not financial aid is requested.

### The Programs

A candidate for the M.A. is expected to complete at least six one-semester courses for credit, and may major either in English and American literature or in creative writing; the thesis of a candidate majoring in creative writing consists of original fiction or poetry. A candidate who so wishes may earn the M.A. with work done solely during four summer sessions.

A candidate for the M.F.A. is expected to complete a workshop course in each of four semesters and a total of eight other courses, of which at least five should be in literature. His thesis is a piece of creative writing (a novel, for example, or a book of poems or of short stories).

A candidate for the Ph.D. is normally expected to complete six one-semester courses for credit in his first year of residence, and a total of at least six more in his second and third years. The program of any doctoral candidate's formal and informal study, whatever his particular interests, should be comprehensive enough to give him some familiarity with (1) the authors and works which have been most influential in determining the course of English and American literature; (2) the theory and criticism of literature; (3) the relations between literature and other disciplines; and (4) such basic scholarly concerns as textual criticism, analytic bibliography, and problems of attribution, authentication, genre, source, and influence. He is encouraged to select one or both of his minors from among the offerings of related Fields. A student electing to major in American studies within the Field of English will define his major to include a minor in history and will choose one minor from some non-American subject in his area of concentration.

Within each of these programs, the special-committee procedure eliminates uniform course requirements and departmental examinations, and serves to provide a close working relationship between professors and students, and to encourage freedom and flexibility in the choice of a route toward the graduate degree. A student's Special Committee directs and judges his progress at a series of meetings with him in which it reviews his course work, the individual work which he has done with members of the Committee and with others, and his own assessments of his progress. The Special Committee of a doctoral candidate must decide at the very latest before he enters his fourth semester of graduate study whether he is qualified to proceed toward the Ph.D.

The Field expects every doctoral candidate to acquire some teaching experience as part of his professional preparation.

### Language Requirement

Foreign language proficiency and the study of the English language are so basic as to be given special emphasis. Each student and his Special Committee will decide what work in these areas is most appropriate to the rest of his graduate program and to his scholarly interests in general.

Some doctoral programs require extensive knowledge of a single foreign language and literature; others require competent reading ability in two or more foreign languages. Programs of study for the M.F.A. normally require reading ability in one foreign language. A student may be asked to demonstrate his competence by, for example, presenting his undergraduate record, taking additional courses in foreign languages and literatures, or translating and discussing documents related to his work in English and American literature.

To pursue his study of the English language, a student may be asked to avail himself of Departmental course offerings in Old English, in the history of the English language, in grammatical analysis, or in the application of linguistic study to the history of English literature, to metrics, or to literary criticism. Several other departments provide courses in such subjects as descriptive linguistics, psycholinguistics, and the philosophy of language.

### Financial Aid

An applicant who wishes a teaching assistantship should check the appropriate blank of his admission-and-fellowship application, and should also write a brief letter

by March 1 to the Chairman, Department of English, Goldwin Smith Hall. Teaching assistantships in English are available only to students who upon taking up teaching duties will have completed at least a year of graduate work.

### Faculty and Specializations

Anglo-Saxon and medieval studies: R. T. Farrell, T. D. Hill, R. E. Kaske, W. Wetherbee III  
 The Renaissance: B. B. Adams, A. V. Ettin, E. G. Fogel, P. A. Gottschalk, B. L. Hathaway, C. V. Kaske, C. S. Levy, D. Novarr  
 The Restoration and the eighteenth century: D. N. Archibald, M. R. Brownell, S. Budick, D. D. Eddy, S. B. Elledge, R. D. Hume  
 The Romantic period: M. H. Abrams, N. H. Hertz, A. R. Parker, S. M. Parrish  
 The Victorian period: J. P. Bishop, J. D. Boyd, F. E. Mineka, D. M. Mermin  
 The twentieth century: H. Kaye, P. L. Marcus, D. E. McCall, A. M. Mizener, S. Siegel  
 American literature: J. F. Blackall, M. J. Colacurcio, R. H. Elias, J. S. Redding, W. J. Slatoff, S. C. Strout  
 The novel: J. R. McConkey, E. Rosenberg, D. R. Schwarz  
 The drama: A. Caputi, M. W. Kaufman, H. S. McMillin, B. O. States  
 Creative writing: A. R. Ammons, B. L. Hathaway, W. P. Matthews III, J. R. McConkey  
 English linguistics: C. E. Elliott, C. F. Hockett

A procedural guide fully describing the graduate programs in English can be obtained upon request to the Field representative.

## Germanic Studies

### Field Representative

Herbert L. Kufner, 212 Rand Hall

### Major Subjects

German Literature, Germanic Linguistics

### Minor Subjects

German Literature, Germanic Linguistics, Old Norse

A good background in German literature and fluency in the German language are required and some acquaintance with Middle High German. A reading knowledge of a foreign language other than German is desirable. Applicants must submit scores of the Graduate Record Examinations Aptitude Test. Both M.A. and Ph.D. degrees are granted, but preference is given to those planning to continue for the doctorate.

For the Ph.D. degree, proficiency in French (for literature majors) or in Russian (for linguistics majors) is required. A qualifying examination is required and is normally given at the end of the first year. For further details, see *The Guide for Graduate Students in German at Cornell University*, available from the Field representative. The doctoral program normally takes four years. Apprentice teaching is an essential part of the program. Provision is made for study abroad, if desirable. Course requirements for the Master's degree can usually be completed within one year; a Master's thesis is required only if the degree is to be a terminal one.

Special opportunities for study abroad include the Schurman Fellowship (for work at the University of Heidelberg), the *Dankstipendium* given by the German Federal Republic, and the German Academic Exchange Service (DAAD) Fellowship.

The student with a major in German literature chooses for special emphasis one of three partially overlapping

## 30 History of Art and Archaeology

periods: German literature before 1700, German literature from 1500–1832, or German literature from 1750 on.

The Program in Germanic linguistics aims at ensuring familiarity with the basic tools of research in linguistics and philology and at providing the student with a thorough knowledge of the structure of modern German, the contrastive analysis of German and English, the history of the German language, four of the older German languages, and comparative Germanic linguistics. Opportunities for studying Old Norse are exceptional; the University's collection of Old Norse materials (the Old Icelandic Collection) is probably the most important of its kind in the world, and its curator, Vilhjalmur Bjarnar, is both a librarian and an Old Norse scholar.

### Faculty and Specializations

#### Literature

Medieval literature and philology: L. Collings, P. Lowe, Jr.  
The late Middle Ages, the sixteenth century: L. Collings, S. L. Gilman  
The seventeenth century: H. Deinert, S. L. Gilman, R. Jayne  
The eighteenth century, the classical age: E. A. Blackall, D. Connor, S. L. Gilman  
Romanticism and realism: E. A. Blackall, H. Deinert, I. Ezergailis  
Twentieth-century literature: D. Connor, H. Deinert, I. Ezergailis, S. L. Gilman, R. Jayne, W. W. Holdheim  
Stylistics: E. A. Blackall  
Literary theory: W. W. Holdheim

#### Linguistics

Old Norse: V. T. Bjarnar, P. Lowe, Jr.  
Netherlandic, Frisian, Gothic, Old High German, Old Saxon, Early New High German, comparative Germanic grammar: F. van Coetsem  
History of the German language, Modern German grammar: E. A. Blackall, H. L. Kufner, P. Lowe, Jr.  
German dialects, applied linguistics, pedagogy: H. L. Kufner  
Professor-at-Large: Elizabeth M. Wilkinson

## History

### Field Representative

Joel H. Silbey, 453 McGraw Hall

### Major and Minor Subjects

American History, American Studies, Ancient History, Early Modern European History, English History, History of Science, Latin American History, Medieval Chinese History, Medieval History, Modern Chinese History, Modern European History, Russian History, Southeast Asian History

Applications for admission must include the scores of the Graduate Record Examinations Aptitude Test. The Field of History does not admit applicants who are applying only for a Master's degree. Applications are only accepted for the fall term.

Each major subject area of study within the Field formulates its own foreign language requirement.

Candidates majoring in the Field of History may take minors within the Field or in other Fields of the Graduate School.

### Faculty

D. Baugh, A. H. Bernstein, D. Davidson, E. W. Fox, H. Guerlac, C. Holmes, J. J. John, M. Kammen, S. Kaplan, H. G. Koenigsberger, D. LaCapra, W. F. LaFeber, L. Moore, M. B. Norton, C. A. Peterson, W. M. Pintner, R. Polenber, W. Provine, J. H. Silbey, F. Somkin, B. Tierney, M. Walker, L. P. Williams, O. W. Wolters, D. Wyatt

## History of Architecture and Urban Development

### Field Representative

Stephen W. Jacobs, 114 West Sibley Hall

### Major and Minor Subjects

History of Architecture, History of Urban Development, Preservation Planning (minor subject only)

Applicants should have an undergraduate degree in architecture; archaeology; planning; ecology; geography; history; history of culture, art, or architecture; or appropriate experience in the field. Applicants residing in the United States must submit scores of the Graduate Record Examinations Aptitude Test. Candidates may apply for the Master of Arts or for the doctoral program; applicants with previous graduate work will be considered for advanced standing. The Master's program is intended to qualify students for research, teaching, specialized practice, or government service. The doctoral program is intended to prepare students to make creative contributions to the field. For M.A. candidates, reading proficiency in at least one modern language other than English is required; for Ph.D. candidates, proficiency in two languages other than English.

It is recommended that students take a qualifying examination early in their program.

A number of teaching assistantships and an occasional research assistantship are available.

### Research and Study Opportunities

The Department of Architecture cooperates with Harvard University in the archaeological exploration of Sardis in Turkey. The Departments of Policy Planning and Regional Analysis and of Urban Planning and Development conduct a program of research in urban and regional studies in cooperation with the Center for Urban Development Research (see p. 22). Research activities are closely related to and derived from faculty interests and specializations, listed below.

### Faculty and Specializations

W. W. Cumber: classical archaeology, building history, history of ancient Near Eastern and classical architecture  
M. Hugo-Brunt: history of maritime, colonial, and oriental architecture and planning  
S. W. Jacobs (Associate Director of the Cornell-Harvard Expedition to Sardis, Turkey): American architecture; preservation programs; eighteenth-, nineteenth-, and twentieth-century European architecture  
B. G. Jones (Acting Director, Center for Urban Development Research): historic preservation planning  
T. W. Mackesey: history of city planning and university planning  
C. F. Otto: history of Renaissance, baroque, and modern architecture  
K. C. Parsons: history of college and university architecture and planning  
J. W. Reps: history of city planning in the United States  
C. Rowe: history of Renaissance and modern architecture, urban design, architectural criticism, contemporary European and American architecture  
S. Stein: preservation planning

## History of Art and Archaeology

### Field Representative

Robert G. Calkins, 32 Goldwin Smith Hall



## Major and Minor Subjects

American Art, Ancient Art and Archaeology, Medieval Art, Modern Art, Oriental Art, Renaissance and Baroque Art

An undergraduate major in the history of art is recommended but not required. All applicants are required to take the Graduate Record Examinations. Applicants should have already begun study of a language appropriate to their intended program; they must demonstrate reading proficiency in the language before becoming candidates for a degree. Each Ph.D. candidate must participate in teaching during at least two terms.

The Department awards several teaching assistantships and a Kress Foundation Fellowship. The Franklin and Gretel Goldring Memorial Fellowship provides summer travel support in Europe for several advanced students.

## Research and Study Opportunities

Major study facilities are provided by the collections of Olin Library, which contain resources of primary material for this field, and of the Fine Arts Library in Sibley Hall, with extensive holdings in art and architectural history. The Andrew Dickson White Museum of Art, which has in its permanent collection significant study material, offers opportunities to gain experience in the operations of the Museum. In addition to the major collections in New York City, Ithaca is within reasonable distance of the Albright Art Gallery in Buffalo, the Memorial Art Gallery in Rochester, and the Munson-Williams-Proctor Institute in Utica. The Department of the History of Art has a study collection of photographs of works of art and a rapidly expanding collection of over 130,000 slides.

History of Architecture may be pursued jointly with the College of Architecture, Art, and Planning. An interdepartmental program is available in archaeology, and a descriptive pamphlet will be sent on request. The Department of Asian Studies also issues a publication describing facilities in Far Eastern Studies. A study archive of Chinese art is being developed. Students of Southeast Asian art can attend a short but intensive seminar conducted each summer by Mr. Alexander Griswold at the Breezewood Foundation near Baltimore, which houses an outstanding study collection of Siamese Art.

## Faculty and Specializations

American art: A. S. Roe, T. Leavitt

Ancient art and archaeology: A. Ramage, J. F. Scott  
(art of Egypt and Mesopotamia, primitive and pre-Columbian Art)

Medieval art and architecture: R. G. Calkins

Modern art: T. Leavitt

Nineteenth-century art and modern architecture:

T. M. Brown

Oriental art: M. W. Young (Chinese and Japanese art),  
S. J. O'Conner, Visiting Professor Alexander B. Griswold  
(art of Southeast Asia and India)

Renaissance and baroque art: A. S. Roe, E. G. Dotson,  
J. F. Scott (art of Latin America), H. P. Kahn (graphics)

## Medieval Studies

### Field Representative

Thomas D. Hill, 245 Goldwin Smith Hall

### Major and Minor Subjects

Medieval Art, Medieval History, Medieval Literature  
(English, German, Latin, Norse, Romance, Semitic,  
Slavic), Medieval Philology (Germanic, Latin, Romance,  
Semitic, Slavic), Medieval Philosophy

The aim of this Field is to allow the student to concentrate more fully upon medieval studies than is possible within the programs of other Fields.

Though certain requirements are absolute (e.g., a reading knowledge of Latin and a course in paleography and research methods), emphasis is on the formulation of individual programs to fit individual interests and needs. Teaching experience is required of all Ph.D. degree candidates

A broad undergraduate major in one of the participating disciplines should ideally precede graduate concentration in this Field. All applicants are strongly urged to take the Graduate Record Examinations Aptitude Test and an appropriate Advanced Test, if such exists.

For the M.A. degree, proficiency in Latin and either French or German is required; for the Ph.D. degree, proficiency in Latin, French, and German.

Further information concerning the Field of Medieval Studies is to be found in the Field's brochure, which can be obtained by writing to the Field representative.

## Faculty and Specializations

B. B. Adams: medieval drama

V. T. Bjarnar: Old Norse language and literature

R. G. Calkins: medieval art and architecture

A. M. Colby: Old French language and literature

L. G. Collings: medieval German language and literature

R. T. Farrell: Old English language and literature; English philology

R. A. Hall, Jr.: medieval Romance languages

T. D. Hill: Old English language and literature

A. L. Ivry: medieval Arabic and medieval Hebrew language and literature; medieval Islamic and Jewish philosophy

J. J. John: Latin paleography; medieval history

R. E. Kaske: Middle English language and literature

N. Kretzmann: medieval philosophy

P. Lowe, Jr.: Old Norse language and literature

G. M. Messing: medieval Latin language and literature

C. Moron-Arroyo: medieval Spanish language and literature

B. Netanyahu: medieval Spanish and Jewish history

I. Rabinowitz: medieval Hebrew language and literature

D. M. Randel: medieval music

R. Scheindlin: medieval Celtic language and literature

B. Tierney: medieval history; canon law

F. van Coetsem: Germanic philology

J. F. Vigorita: medieval Hebrew and Arabic literature

W. Wetherbee III: medieval Latin and Middle English language and literature; Arthurian literature

## Music

### Field Representative

Neal Zaslaw, Lincoln Hall

### Major and Minor Subjects

Musical Composition, Musicology, Theory of Music, Musical Performance (minor for M.F.A. only)

All applicants must take the test of musical proficiency prepared by the Music Department either at Cornell or by mail with the use of tape recordings, as well as a written music history and analysis examination. Sample copies of the test and further information may be obtained from the Office of the Department of Music. Applicants are asked also to submit scores of the Graduate Record Examinations Aptitude test. The GRE test in music is optional.

For the M.F.A. and D.M.A. degrees and the M.A. in theory, the Field requires a reading knowledge of French or German; for the Ph.D. and M.A. in musicology, a reading knowledge of both.

**The Program and Facilities**

Musical composition, performance, and scholarship are reciprocal parts of a coherent enterprise to which studies at Cornell are devoted. The concern to coordinate them is continuous and intense. Work within each of the major subjects is supplemented by continuing experience in singing and playing, especially in ensembles. The teachers who specialize in performance are particularly interested in new music and in newly discovered old music, without neglecting the classics. Each individual student must seek his own balance of interests in accordance with his abilities and opportunities.

The Ph.D. degree is conferred in musicology; the Doctor of Musical Arts degree (D.M.A.) and the Master of Fine Arts degree (M.F.A.) in composition; and the M.A. degree in musicology or theory.

The Music Library, housed in Lincoln Hall, has an excellent collection of the standard research tools; its holdings consist of 50,000 books and scores and 13,000 records. Particularly noteworthy are the collections of opera scores from all periods, twentieth-century scores and recordings, and a large microfilm collection of Renaissance sources, both theoretical and musical. In addition, the Department of Rare Books in Olin Library contains an important collection of early printed books on music and musical manuscripts.

The Verne S. Swan collection of about fifty musical instruments is especially rich in old stringed instruments. A small Challis harpsichord and clavichord are available for practice; a Hubbard harpsichord is reserved for concerts. There is an Aeolian-Skinner organ in Sage Chapel, a Schlicker organ at Barnes Hall, and a Hellmuth Wolff organ in Anabel Taylor Chapel. A studio for electronic music was built in 1970.

The Department of Music and the Faculty Committee on Music sponsor more than forty concerts each semester by world-renowned musicians, faculty members, and students.

**Faculty and Specializations**

- W. Austin: history of twentieth-century music, nineteenth-century music in Russia and America, philosophy of music
- M. Bilson: the fortepiano of the eighteenth and early nineteenth centuries, piano literature
- J. Hsu: literature and technique of the viols and violoncello
- K. Husa: composition, orchestration, conducting
- S. Lubin: nineteenth-century music, music theory
- R. Palmer: composition, general theory, theory of twentieth-century tonality
- D. Randel: medieval and Renaissance music, especially in Spain
- T. Sokol: choral music, conducting, performance styles
- J. Webster: eighteenth- and nineteenth-century music
- N. Zaslaw: baroque and classical music, history of music theory, performance practice

Also available for consultation are members of the graduate faculty in music at the State University of New York at Binghamton, including:

- S. Chianis: ethnomusicology, organology, music history
- W. Klenz: baroque music, performance practice, music aesthetics
- H. B. Lincoln: nineteenth-century music, computers in music research
- H. M. Brown, Professor at Large

**Philosophy****Field Representative**

Sydney Shoemaker, 228 Goldwin Smith Hall

**Major and Minor Subjects**

Logic and Philosophy of Science, History of Philosophy, Metaphysics and Epistemology, Philosophy (minor subject only), Values and Conduct

The Susan Linn Sage School of Philosophy, which comprises the Field of Philosophy in the Graduate School, was founded through the generosity of Henry W. Sage. There are at present twelve faculty members engaged in full-time instruction and two in part-time instruction. The faculty manages and edits *The Philosophical Review*.

A background in philosophy equivalent to a Cornell undergraduate major is presupposed, and deficiencies must be made up in addition to graduate work. Applicants for the Ph.D. program are given preference, though the Field will sometimes accept M.A. degree candidates.

A student whose major interest is in philosophy is required (a) to gain a general knowledge of the whole subject including its history, and (b) to select some aspect or subdivision of it for intensive study and research.

A doctoral candidate is normally in residence for four years. During the first two years he takes three courses or seminars per semester and prepares for the admission to candidacy examination. During the second two years, he writes his thesis.

The meetings of the Philosophy Discussion Club are among the outstanding features of the program. Every fortnight the Club meets to hear and discuss a paper from one of its members or a visiting scholar. A number of distinguished philosophers visit the Club every year.

If there is doubt whether a new student should continue study for the Ph.D. degree, he will be given an examination early in the second semester based on the written work done in his first semester and on any other materials he wishes taken into account. The same criterion is used to determine whether a terminal M.A. degree candidate shall proceed to the writing of an M.A. essay.

The Field requires teaching experience for all Ph.D. candidates.

**Joint Program in Ancient Philosophy with the Field of Classics**

The object of the joint program is to meet the demand for scholars of ancient philosophy who are competent in both philosophy and classics. At present there are three scholars of ancient philosophy in the program: Norman Kretzmann, Russell Dancy, and Michael Stokes (classics).

The course requirements include two courses on Plato (one in the Department of Classics, one in the Department of Philosophy); two courses on Aristotle (similarly divided); two additional courses in the Department of Classics; two additional courses in the Department of Philosophy; four remaining courses determined by consultation with the student's Special Committee.

Participants should have had three years of Greek on admission, or should pass a sight-reading test in Greek after one semester.

**Faculty and Specializations**

- M. Black: philosophy of mathematics, philosophy of science, philosophy of language, philosophy of logic
- R. Boyd: philosophy of science, philosophy of mathematics, logic
- O. Chateaubriand: logic, philosophy of language, metaphysics
- R. Dancy: ancient philosophy, epistemology
- C. Ginet: epistemology, philosophy of mind
- B. C. Goldberg: history of philosophy, philosophy of mind, philosophy of language

N. Kretzmann: medieval philosophy and logic, ancient philosophy and logic, history of semantics  
 D. B. Lyons: moral, political, and legal philosophy  
 N. Malcolm: epistemology, philosophy of mind, history of philosophy, metaphysics  
 S. Shoemaker: metaphysics, philosophy of mind, history of philosophy  
 R. Stalnaker: philosophy of language, metaphysics, philosophy of logic  
 N. Sturgeon: ethics, philosophy of mind  
 A. W. Wood: continental philosophy, history of philosophy, philosophy of religion, ethics, philosophy of history  
 Professor-at-Large Georg Henrik von Wright: philosophy of science, philosophical logic, moral philosophy

## Romance Linguistics

### Field Representative

Robert A. Hall, Jr., 241 Morrill Hall

### Major and Minor Subjects

French Linguistics, Italian Linguistics, Romance Linguistics, Romance Philology, Spanish Linguistics

The student in Romance linguistics is given training in four types of study and research: (1) general principles of linguistic analysis; (2) the description of the structure of the Romance language of his major interest; (3) the external and internal history of that language; and (4) the genetic and typological relationships of the Romance family of languages. Special emphasis is laid on the relation between linguistic history and cultural factors (literary, political, and social). A concomitant aim of this area is to afford instruction and practice in the application of linguistics to the teaching of one or more Romance languages.

A candidate may choose as his major subject either the linguistics (descriptive and historical) of a specific Romance language or the comparative study of the Romance languages. He will normally have as one of his minor subjects the literature of the language in which his major interest lies.

For further information, see Romance Studies, Medieval Studies, and Linguistics in this *Announcement*.

The Field requires applicants to submit scores of the Aptitude and Advanced Tests of the Graduate Record Examinations. Qualified students may be admitted directly to the Ph.D. program.

For the M.A., a candidate is expected to have command of two Romance languages (including the language of his major concentration), and the equivalent of a first-year course in Latin. For the Ph.D., a command of French and German is expected, plus the equivalent of a second-year course in Latin.

An effort will be made to provide an opportunity for classroom experience to qualified candidates interested in teaching. Ordinarily, students will not teach during their first year of residence.

Those who wish to acquire the Master's degree for teaching at the secondary-school level will be encouraged to apply to Cornell's Master of Arts in Teaching program.

In addition to the examinations required by the Graduate School, Ph.D. candidates are required to take a qualifying examination not later than the end of the second semester of residence, and, in the case of students entering with an M.A. in Romance literature or linguistics, normally during their first semester.

Students entering Cornell without a good background in Romance linguistics should normally expect to take two

years for the M.A. and four years for the Ph.D. It is not required that an M.A. degree be earned on the way to the Ph.D. degree.

### Faculty and Specializations

F. B. Agard: comparative Romance linguistics, Portuguese, Rumanian  
 A. M. Colby: French philology, medieval French language and literature, stylistics  
 R. A. Hall, Jr.: comparative Romance linguistics, Italian language and literature, pidgin and creole languages  
 J. S. Noblitt: comparative Romance linguistics, French linguistics and philology, programmed learning  
 L. Sangster: French linguistics, semantics  
 D. F. Solá: Spanish linguistics, Quechua  
 D. M. Stillman: Spanish linguistics

## Romance Studies

### Field Representative

John W. Kronik, 292 Goldwin Smith Hall

### Major and Minor Subjects

French Literature, Italian Literature, Spanish Literature

Graduate study in Romance literature is designed to train students as scholars and as teachers of language and literature. The Field expects its candidates to acquire a basic knowledge in areas such as the following: textual criticism, literary history, intellectual history, philology, social and political history, biography, linguistic theory. Students are expected to develop the necessary skills for a critical understanding of texts, explicating texts, annotating and editing texts, and identifying and developing critical and scholarly problems. The Field welcomes students from other departments wishing to prepare a minor in Romance studies.

The student's area of study need not be conceived as delimited by the history of one national literature. Each student is encouraged to take advantage of available flexibility and to define his field broadly, in relation to such disciplines as history, art history, music, anthropology, philosophy, and the study of classical or other modern national literatures.

The Field discourages premature specialization. It recognizes that the student of modern literature who lacks a broad and precise sense of a cultural tradition will tend to be shallow and naive; the student of earlier periods, unless well advised of the literary and critical climate of our own day, may become narrowly antiquarian in his scholarship.

Old Field requirements have been replaced by a flexible consultative process: as the student advances in his studies, his Special Committee will recommend that he acquire those languages and other skills which will be necessary to further work in his individually defined field of studies.

Applicants must include scores of the Aptitude and Advanced Tests of the Graduate Record Examinations with their other credentials, and are urged to take the examinations by mid-December. All qualified students are admitted directly to the Ph.D. program. Upon entry each new student is interviewed by faculty members on his preparation and readings. Students are also expected to speak and write their major language with fluency and correctness; those who cannot demonstrate fluency will be encouraged to do at least one year's course work in their major language. Other language requirements are set by the student's Special Committee and will depend upon his particular needs and interests.

## 34 Slavic Studies

All efforts will be made to provide an opportunity for classroom experience to qualified candidates interested in teaching. Ordinarily, students will not teach during their first year of residence.

Those who wish to acquire the Master's degree for teaching at the secondary-school level are encouraged to apply to Cornell's Master of Arts in Teaching program.

The Field offers the opportunity to spend one year abroad to students who have passed the admission to candidacy examination.

The Field strongly encourages study in related areas, e.g., comparative literature; Romance linguistics; medieval studies; Renaissance studies; eighteenth-century studies; Latin American studies; and so on.

Distinguished visiting scholars and writers in the Department of Romance Studies in recent years have included Arthur Adamov, Charles Aubrun, C. P. Brand, Moshé Lazar, Margaret M. Phillips, Octavio Paz, R. B. Tate, and Paul Zumthor. The seminars of the Society for the Humanities are open to graduate students in the Field and have recently included courses taught by such eminent specialists as Northrop Frye, Jean Seznec, and Frances Yates.

In addition to the generally strong library holdings, Cornell is fortunate to have in its main library the renowned Fiske collections of books pertaining to Dante and Petrarch, which afford unique opportunities for scholarly research.

For the complete listing of courses offered in a given year and description of their contents, see the *Announcement of the College of Arts and Sciences*. The Field's procedural guide, which describes the program in detail, may be requested from the Field representative.

### Faculty and Specializations

- J. Béreaud: stylistic and French civilization
- G. P. Biasin: nineteenth- and twentieth-century Italian literature
- G. Celati: Renaissance Italian literature
- A. M. Colby: medieval French literature
- U. J. De Winter: twentieth-century Spanish literature
- H. Dieckmann: sixteenth- and eighteenth-century French literature and comparative literature
- N. Furman: nineteenth-century French literature
- R. O. González: Golden Age Spanish and modern Spanish American literature
- D. I. Grossvogel: twentieth-century French literature
- L. Kerr: Spanish American literature
- J. W. Kronik: nineteenth- and twentieth-century Spanish literature
- P. E. Lewis: seventeenth- and nineteenth-century French literature
- J. Mehlman: nineteenth- and twentieth-century French literature
- C. Morón-Arroyo: Spanish intellectual history, medieval and modern literature
- E. P. Morris: sixteenth-century French literature
- A. Seznec: seventeenth-century literature

## Semitic Studies

### Field Representative

Calum M. Carmichael, 162 Rockefeller Hall

### Major and Minor Subjects

Hebrew, Arabic, Aramaic (including Syriac), Biblical Studies

Semitic studies at Cornell are concerned especially with those Semitic languages and literatures in the orbit of

whose users, molders, and creators there emerged the three world religions of Judaism, Christianity, and Islam.

The program, as it is now constituted, is designed to help students acquaint themselves with the most fundamental elements of the aforementioned languages and literatures and also to acquire a high degree of specialization in one or more areas of: (1) ancient and medieval Arabic literature, (2) Jewish and Islamic medieval philosophy, (3) medieval and modern Jewish history, (4) modern Hebrew literature, and (5) Biblical studies.

Candidates for the Ph.D. degree will be expected to demonstrate mastery in the language or languages of the main texts which will be directly related to the topic of their dissertations. Students are advised to determine early in their training the special field of their concentration and to consult their advisers regarding their linguistic requirements.

Candidates for the Ph.D. degree whose major subject is Biblical studies must demonstrate special proficiency in the original languages of the Old and New Testaments, and in those of the chief ancient versions: Hebrew, Aramaic, Greek, Latin, and Syriac. All candidates majoring in the Field will be expected to have at least three years of undergraduate study of one Semitic language, or the equivalent, before admission.

Before the end of the fourth term of graduate study, each Ph.D. candidate must demonstrate competence in reading scholarly materials in any two of the following languages: French, German, Italian, Latin, Russian, Spanish. Candidates for the master's degree must demonstrate competence in one of the foregoing, or in Greek, at least one term before the degree is awarded.

### Faculty

C. M. Carmichael, A. L. Ivry, B. Netanyahu, S. Nash, R. Scheindlin, I. Rabinowitz

## Slavic Studies

### Field Representative

Patricia Carden, 192 Goldwin Smith Hall

### Major and Minor Subjects

Russian Literature, Slavic Linguistics

The student in Slavic studies plans an individual program in consultation with the chairman of his Special Committee and other members of that Committee representing the minor subjects. A student who chooses either Russian literature or Slavic linguistics as a major may choose the other for a minor, or he may choose minor subjects from other Fields in the University, e.g., other literatures, linguistics, history, government, economics, psychology, mathematics, computer science, philosophy, music, etc. A Ph.D. candidate will normally have two minor subjects, although it is possible, in consultation with the chairman of his Special Committee, to plan a program of studies with only one; in the latter case the student is still required to select a total of three professors to serve on his Special Committee.

The progress towards the degree is determined by oral and written comprehensive examinations given at three points in the student's career: at the end of the first year of work to assess the student's capacity for Ph.D. work and to assist in planning the student's program of study; at the end of the third year of study (or sooner if the student is prepared) to assess the student's mastery of the materials of study; and after completion of the dissertation (defense of the dissertation).



Candidates for the M.A. degree are required to demonstrate a reading knowledge of either French or German. Candidates for the Ph.D. are required to demonstrate a reading knowledge of both languages.

Candidates for the Ph.D. degree are normally required to spend two semesters as teaching apprentices as a part of their training towards the degree.

### Faculty and Specializations

- L. Babby: Slavic linguistics
- R. Brecht: Slavic linguistics
- P. Carden: twentieth-century prose, modernism and the avant-garde
- G. Gibian: nineteenth-century prose, 1920s, contemporary literature
- A. Glasse: eighteenth-century literature, Russian romanticism, Russian drama
- R. Leed: historical Slavic linguistics, Russian dialectology, intonation

## Theatre Arts

### Field Representative (M.A./Ph.D.)

Marvin A. Carlson, 106 Lincoln Hall

### Field Representative (M.F.A.)

Stephen R. Cole, 110 Lincoln Hall

### Major and Minor Subjects

Theatre History, Theatre Theory and Aesthetics, Drama and the Theatre, Design for the Theatre (minor only), Playwriting (minor only)

For the M.A. and Ph.D. degrees, Graduate Record Examinations Aptitude Test scores are required. For the M.F.A. degree, interviews and screening sessions are normally required. Direct admission to the doctoral program is normally restricted to those with M.A. degrees.

The normal language requirement for the Ph.D. degree is proficiency in two foreign languages, but the Special Committee may approve a single language at a higher proficiency. For the Ph.D., a qualifying examination is given in the third term of residence; it may be combined with the final examination for the M.A. degree. The program leading to the Master of Fine Arts degree (in acting/directing) requires a minimum of two years in residence and emphasizes training in workshop and studio. A final project replaces the conventional final examination. The M.F.A. is normally a terminal degree.

### Research and Study Opportunities

The chief aim of the Ph.D. program in Theatre Arts is to develop competent scholars, teachers, and directors for the educational theatre. Therefore, research, teaching, and production will be, to a meaningful extent, involved in each Ph.D. program.

Opportunities are offered for study and research in many phases of the discipline, including dramatic literature; history, criticism, and aesthetics of the theatre; playwriting; and most aspects of theatrical production.

### Faculty and Specializations

- M. A. Carlson: dramatic literature, theatre history
- J. H. Clancy: directing, dramatic literature, theatre aesthetics
- S. Cole: acting, directing, theatre aesthetics
- B. O. States: playwriting, dramatic structure

## Social Sciences

**African and Afro-American Studies, Agricultural Economics, Anthropology, Asian Studies, Business and Public Administration, City and Regional Planning, Communication Arts, Consumer Economics and Housing, Design and Environmental Analysis, Development Sociology, Economics, Education, Government, Hotel Administration, Human Development and Family Studies, Industrial and Labor Relations, International Agricultural Development, Latin American Studies, Law, Linguistics, Psychology, Public Policy, Regional Science, Sociology, Statistics, Urban Studies**

## African and Afro-American Studies

### Field Representative

J. Congress Mbata, Africana Studies and Research Center

### Major Subject

Africana Studies

The Field offers a program leading to the degree of Master of Professional Studies (African and African-American). It is primarily intended for students interested in specializing in scholarly work—teaching, research, or creative arts—in some facet of the rapidly developing academic area of Black studies.

Applicants must previously have taken courses in the following groups of subjects: *African Heritage*—ancient history of African peoples, African dispersion, the Black man in the twentieth century; *African Behavior*—psychology, sociology, anthropology, adaptations to changing environments; *Black Expression*—literature, language, theatre, arts; *Africanization and African Political Thought, Racism, Social Structure, and Social Analysis*—urban and rural social conditions of the Black population, land use patterns and community development, social institutions and political processes; *Techno-Africana*—technology and the Black man, the professions (the medical practitioner and the Black community, the lawyer and the Black community, etc.). The student must have selected one of these groups as an area of concentration and must have taken at least one course from each of four of the remaining groups. With the special permission of the Africana Graduate Studies Committee, part of the admission requirements may be taken concurrently with graduate work.

Under the supervision of the Africana Studies and Research Center, the area of Black studies is still being established and defined, and students will participate significantly in its direction and development. To assure continued relevance to the community as well as to provide an area for field research and experience and a base for functional community programs, an urban resident center is being established. Planned areas of research include many previously ignored facets of Black existence as well as the contemporary political, economic, and social policies that shape the life of the Black community. The Africana Center also wishes to encourage creative artists searching for a Black aesthetic and to help develop new materials, approaches, and personnel for teaching Black studies and Black children.

### Faculty

C. Everett, J. C. Mbata, R. Murapa, J. Turner

## Agricultural Economics

### Field Representative

Olan D. Forker, 205 Warren Hall

## Major and Minor Subjects

Agricultural Economics, Farm Management and Production Economics, International Economics and Development, Marketing and Food Distribution, Policy and Prices, Public Administration and Finance, Resource Economics

The Field offers graduate training leading to the Master of Professional Studies, Master of Science, and Doctor of Philosophy degrees. A student may elect to follow a terminal M.S. program.

Students who wish to obtain a Ph.D. degree are usually expected to obtain a Master's degree first, but direct admission to a Ph.D. program may be considered if the applicant's preparation for graduate work is outstanding. All applicants are urged to take the Graduate Record Examinations Aptitude Test; those seeking fellowships must do so.

The student may pursue research in any of the areas suggested by the major subjects. Other faculty interests include agricultural cooperatives, agricultural geography, business management, farm finance, international trade, regional agricultural development, resource economics, and quantitative methods as applied to problems in agricultural economics. Within the area of economic development, staff members have special interests in Latin America, the Middle East, South and Southeast Asia, and in tropical agriculture generally.

Assistantships in this Field provide an opportunity for part-time employment in teaching, research, or extension. Thesis research is often conducted as a part of assistantship duties.

## Faculty and Specializations

Farm management and production economics:

C. A. Bratton, G. L. Casler, H. E. Conklin,  
G. J. Conneman, D. L. Good, C. D. Kearl, E. L. LaDue,  
C. W. Loomis, R. S. Smith, B. F. Stanton

International economics and development:

S. L. Barraclough, D. K. Freebairn, J. W. Mellor,  
T. T. Poleman

Marketing and food distribution: R. D. Aplin, E. H. Brown,  
M. E. Brunk, D. L. Call, L. B. Darrah, W. G. Earle,  
D. A. Eiler, O. D. Forker, D. C. Goodrich, G. W. Hedlund,  
R. B. How, J. F. Metz, D. I. Padberg, R. P. Story

Policy and prices: T. D. Mount, K. L. Robinson,  
D. G. Sisler, W. G. Tomek

Public administration and finance: E. A. Lutz, H. P. Mapp

Resource economics: D. J. Allee, R. N. Boisvert,  
L. D. Chapman, R. J. Kalter

## Anthropology

### Field Representative

John V. Murra, 227 McGraw Hall

### Major Subject

Anthropology — Since the faculty conceives of its disciplines as a unified field, only one major, Anthropology, is offered.

### Minor Subjects

Applied Anthropology,\* Archaeology, Physical Anthropology, Social Anthropology — There are three foci of strength in Social Anthropology at Cornell, each of which can be a minor field of inquiry: Culture and Meaning, Social Organization, Historical Anthropology. A student may opt for training as a generalist or he may choose a specialty.

\*Applied Anthropology is available only to those whose major is in another Field.

A faculty committee, plus a voting graduate student elected by her or his peers, with the Field representative as chairman, evaluates all applications for admission and awards. All applicants resident in the United States during the year preceding matriculation must submit the scores of the Graduate Record Examinations Aptitude Test. Those who are accepted, but who are not in the United States at the time of application, must submit scores by the close of their first year at Cornell.

The Field of Anthropology recommends that candidates seeking a career in anthropology plan to complete a Ph.D. program. Only under exceptional circumstances and by invitation will students interrupt their training at the M.A. level.

The minimum language requirement beyond the language or languages used in the field is determined by the candidate's Special Committee.

Every graduate student is expected to gain experience in classroom teaching.

## Faculty and Specializations

American Indian: C. F. Hockett

Anthropological history and theory: D. J. Greenwood,

K. A. R. Kennedy, A. T. Kirsch, B. Lambert, J. V. Murra,  
L. Sharp, R. J. Smith

Applied anthropology and culture change: L. Sharp,  
R. J. Smith

Archaeology: R. Ascher, J. S. Henderson, T. F. Lynch

Chinese studies: D. R. DeGlopper

Comparative religion: A. T. Kirsch, M. E. Meeker, L. Sharp,  
J. T. Siegel

Cross-cultural studies: W. W. Lambert, F. W. Young

Culture and meaning: L. W. Hazlehurst, A. T. Kirsch,  
M. E. Meeker, J. T. Siegel

Economic anthropology and technology: D. J. Greenwood,  
J. V. Murra

Expressive culture (art, folklore, literature, games, models):  
R. J. Smith

Historical anthropology: D. R. DeGlopper, D. J. Greenwood,  
C. F. Hockett, A. T. Kirsch, J. V. Murra,

R. J. Smith, W. A. Stini

Japanese studies: R. J. Smith

Latin American studies: T. Gregor, J. S. Henderson,

T. F. Lynch, J. V. Murra, R. B. Thomas, F. W. Young

Linguistics: C. F. Hockett

Near Eastern studies: M. E. Meeker

Oceania: B. Lambert, L. Sharp

Physical anthropology: K. A. R. Kennedy, W. A. Stini,  
R. B. Thomas

Political anthropology: M. E. Meeker, J. V. Murra, L. Sharp

Psychological anthropology: W. W. Lambert

Social organization: D. R. DeGlopper, D. J. Greenwood,

T. A. Gregor, L. W. Hazlehurst, C. F. Hockett,

B. Lambert, M. E. Meeker, J. T. Siegel, L. Sharp,

R. J. Smith

South Asian studies: L. W. Hazlehurst, K. A. R. Kennedy

Southeast Asian studies: A. T. Kirsch, L. Sharp, J. T. Siegel

Urban studies: L. W. Hazlehurst, J. T. Siegel, R. J. Smith

Professors-at-Large: Cora DuBois (Department of  
Anthropology, Harvard University), L. S. B. Leakey

(Centre for Prehistory and Paleontology, Nairobi, Kenya),  
M. N. Srinivas (Department of Anthropology, University  
of New Delhi, India).

For detailed information about the staff, policies, and curriculum, please request the green brochure from the Field representative's office.

## Asian Studies

### Field Representative

Tsu-lin Mei, 154 Rockefeller Hall

### Minor Subjects

Asian Studies, East Asian Linguistics, South Asian Linguistics, Southeast Asian Linguistics

Asian Studies is a *minor* Field of concentration at Cornell; consequently a prospective student must first be admitted to a *major* Field of the Graduate School.

The Ph.D. candidate may select a minor in the Field consisting of either (a) concentrated interdisciplinary study of one area of Asia, or (b) disciplinary or topical concentration which cuts across area boundaries. Because specialization in Asia usually involves the study of an Asian language, it is essential that the candidate discuss the problem of language work with the entire membership of his Committee, particularly with the member representing his major Field.

Major and minor work is also offered in various social science Fields and in Oriental art, in Chinese literature, in medieval or modern Chinese history, and in Southeast Asian history.

There are at Cornell three programs concerned with teaching and research on Asia—the China Program, South Asia Program, and Southeast Asia Program.

The National Defense Education Act supports, at Cornell, language and area centers in East Asia, South Asia, and Southeast Asia. Languages currently offered are Burmese, Cambodian, Cebuano, Chinese (Mandarin, Cantonese, and Hokkien), Hindi, Indonesian, Japanese, Javanese, Malay, Pali, Sanskrit, Sinhalese, Tagalog, Tamil, Thai, and Vietnamese.

Graduate students in Asian Studies are eligible for the National Defense Foreign Language Fellowships offered by the United States Office of Education; application forms should be requested from the Graduate School. They are also eligible for the Foreign Area Training Fellowships administered by the Social Science Research Council for study in the United States and for research overseas. Qualified graduate students who are citizens of the United States may apply for Fulbright teaching and research awards for Taiwan, India, Japan, Malaysia, Pakistan, Philippines, and Thailand.

For additional details, consult the Department of Asian Studies, 100 Franklin Hall.

### Faculty and Specializations

#### China

M. G. Bernal: government  
N. C. Bodman: linguistics  
N. R. Chen: economics  
D. R. DeGlopper: anthropology  
T. C. Liu: economics  
J. McCoy: linguistics and literature  
T. L. Mei: literature and philosophy  
D. Mazingo: government, international relations  
C. A. Petersen: medieval history  
K. M. Wong: literature  
M. W. Young: art history

#### Japan

R. T. Freeman: economics  
E. Jorden: linguistics  
T. J. Pempel: government  
R. J. Smith: anthropology  
E. Terasaki: literature  
M. W. Young: art history

#### South Asia

D. E. Ashford: government, public administration  
R. D. Colle: communication arts  
A. T. Dotson: government, development planning  
C. E. Elliott: linguistics  
E. C. Erickson: rural sociology

J. W. Gair: linguistics  
M. D. Glock: education  
L. W. Hazlehurst: anthropology  
G. Kelley: linguistics  
K. A. R. Kennedy: anthropology  
J. B. Long: religion  
R. MacDougall: architecture  
J. W. Mellor: economics  
G. M. Messing: classics  
S. J. O'Connor: art history  
T. T. Poleman: agricultural economics  
D. G. Sisler: agricultural economics

#### Southeast Asia

B. R. O'G. Anderson: government  
A. T. Dotson: government  
J. M. Echols: linguistics and literature  
F. H. Golay: economics  
F. E. Huffman: linguistics  
R. B. Jones, Jr.: linguistics  
G. McT. Kahin: government  
A. T. Kirsch: anthropology  
S. J. O'Connor: art history  
L. Sharp: anthropology  
J. T. Siegel: anthropology  
J. U. Wolff: linguistics  
O. W. Wolters: history  
D. K. Wyatt: history

#### Visiting Professors

China: A. C. Graham, London University  
Southeast Asia: Alexander B. Griswold, Breezewood Foundation; D. G. E. Hall, Professor Emeritus, London University

## Business and Public Administration

### Field Representative

Thomas R. Dyckman, 504 Malott Hall

### Major and Minor Subjects

Managerial Economics, Organization Theory and Behavior, Quantitative Analysis for Administration, Accounting, Business Policy, Business and Public Policy, Finance, International Development, Marketing, Medical Care Organization and Administration, Production and Operations Management, Public Administration, Transportation Economics and Policy

The most desirable preparation is strong undergraduate work in such relevant fields as economics, government, sociology, psychology, mathematics, or engineering; plus a distinguished record in a program leading to the M.B.A. or M.P.A. degree, or the equivalent. Some students are admitted directly from a Bachelor's degree program. A knowledge of mathematics at least through calculus is desirable. Students may not register for an M.A. or M.S. degree in this Field; those desiring a Master's degree should examine the *Announcement of the Graduate School of Business and Public Administration*.

Applicants, both foreign and domestic, must submit aptitude test scores for either the Admission Test for Graduate Study in Business or the Graduate Record Examinations.

The Ph.D. program in this Field is intended to prepare students for teaching and research in administration in the context of one or more of the institutional frameworks involved—business, government, and health care. Unlike the professional M.B.A. and M.P.A. programs, its primary task is not preparing practitioners.

In addition to the examinations required by the Graduate School, candidates will be given a qualifying examination, which is basically diagnostic, soon after registration.

A considerable number of assistantships and several fellowships are awarded annually.

### Subject Descriptions

**Managerial Economics** concentrates on economic analysis for decision making. A candidate may study the problems of the total economy, of industries, or of the firm, and may do so within the context of any particular study area, such as international economic relations, economic development, business-government relations, money and banking, investment project analysis, or transportation.

**Organization Theory and Behavior** focuses on social and behavioral science approaches to the study of human activity in organizational settings. The major concern is with regularities, differences, and relationships in purposive behavior. A fundamental grounding in at least one of the basic behavioral disciplines is essential.

**Quantitative Analysis for Administration** stresses the modern developments in the uses of mathematical and statistical tools and computer technology for the solution of managerial problems.

**Accounting** deals with the theory and practice of developing financial data for two purposes: enabling management to control and plan the development of the enterprise and enabling others to appraise its condition.

**Business Policy** involves the study of business corporations, and particularly of the strategy developed to meet various problems both internal and external. Knowledge of marketing, production, finance, personnel and labor relations, and accounting is essential.

**Business and Public Policy** involves the study of the three-way relationship among individuals, business firms, and government. Emphasis is placed on the impact of public policies and regulations on business and of business policies on government.

**Finance** focuses on the financial structures and requirements of corporations of various types, the problems of maintaining sound financial condition, the organization and behavior of financial markets of different types, and the influence of public policies on these markets and on corporate finance. A knowledge of accounting is essential.

**International Development** deals with the problems of establishing effective public and business institutions in developing parts of the world, with special emphasis on problems of both public and private administration. A good background in one or more of the basic disciplines of economics, government, sociology, or anthropology is highly desirable.

**Marketing** is the study of how the analytical tools derived from economics, psychology, sociology, and operations research can be applied in marketing and in appraising markets. Potential areas of study range from analysis of consumer behavior to research in the decision-making process in the management of marketing organizations.

**Medical Care Organization and Administration** comprises the study of the problems of public policy and administration associated with organization, financing, and delivery of personal health services. Health services are studied employing a systems framework.

**Production and Operations Management** emphasizes the study of quantitative methods of analysis, including the use of the computer, in the solution of major economic decision problems of production and operations management.

**Public Administration** involves an interdisciplinary approach to the study of governmental policies, policy formulation, power relationships, administrative behavior, basic management functions, and the broad environment

of public affairs. Competence in bureaucratic and organizational theory and in the methods of the social sciences is expected.

**Transportation Economics and Policy** deals with an important business function influencing the geographical structure of economic life.

### Faculty

D. E. Ashford, R. M. Battistella, F. T. Bent, H. Bierman, E. Brooks, D. R. Brown, J. B. Bugliari, L. C. Carter, H. J. Davidson, A. T. Dotson, T. R. Dyckman, E. S. Flash, F. F. Gilmore, J. E. Hass, T. R. Hofstedt, J. G. B. Hutchins, S. Kelman, D. C. Knapp, A. J. Kover, T. M. Lodahl, N. R. Lyons, A. K. McAdams, J. O. McClain, V. R. Rao, J. M. Rathmell, R. Schramm, S. Smidt, D. B. Smith, B. K. Stone, D. A. Thomas, L. J. Thomas, R. D. Tollison, K. E. Weick, T. D. Willett

## City and Regional Planning

### Field Representative

Sidney Saltzman, 105 West Sibley Hall

### Major Subjects

City and Regional Planning, Planning Theory and Systems Analysis, Regional Science, Urban Planning History, Urban and Regional Theory

### Minor Subjects

Environmental Planning and Design, Planning Theory and Systems Analysis, Regional Economics and Development Planning, Regional Science, Social and Health Systems Planning, Urban Planning History, Urban and Regional Theory

All applicants resident in the United States during the year preceding matriculation must submit scores of the Graduate Record Examinations Aptitude Test taken within the previous two years.

The Field offers one program with two concentrations leading to the professional degree of Master of Regional Planning (M.R.P.) and one program leading to the Ph.D. degree. Students may apply for either concentration in the Master's program or for the doctoral program as Master's degree candidates. However, applicants with previous graduate work equivalent to one year or more in the Cornell M.R.P. program will be considered for advanced standing or direct admission to doctoral study. Master's degree candidates may apply for transfer to the Ph.D. program after completing two semesters or after taking the M.R.P. degree.

Several graduate research and teaching assistantships are available as are a number of Public Health Service Traineeships in environmental health planning and comprehensive health planning. National fellowship programs available to support study in the Field include those of the Department of Housing and Urban Development, and the Loula D. Lasker Foundation. University loans are also available in special situations.

### Aims and Operations of the Field

The two concentrations in the Master's program are intended to prepare students for professional practice, and the doctoral program is intended to prepare students to make creative contributions to the field through research, teaching, policy development, and practice.

The course offerings in the Field are provided by two departments. One of these, the Department of Urban Planning and Development, is intended to focus mainly on applied programs with attention given to the determinants



of land use and arrangement of space within cities and regions and the influence on the urban environment of economic, social, and political matters. The other, the Department of Policy Planning and Regional Analysis, is concerned with both applied and theoretical aspects of planning for the public sector at the urban, regional, and national levels with primary emphasis on policy issues in social, economic, environmental, and spatial systems.

The concentration in the Master's program administered through the Department of Urban Planning and Development normally requires two years. During the first year the student pursues required foundation courses in urban planning and development, environmental planning and design, urban theory, and planning theory and analysis. He also develops a focus in one of several areas including: history of planning or urban development, comprehensive land use or functional planning, housing and urban development policies and programs, planning process and land-use controls, or environmental planning. Electives, workshops, and a thesis complete the program.

The concentration in the Master's program administered through the Department of Policy Planning and Regional Analysis normally requires two years also. In the first year the student is expected to achieve minimal competence not previously attained in such areas as urban and regional theory, planning theory, planning institutions and practice, mathematical concepts, statistics and decision theory, computer applications, and analytical techniques. He can then focus his study in such areas of application as: urban and environmental systems planning, regional economics and development planning, social policy planning, or health systems and housing; or he can pursue a more general program. Field work experience in the summer between the two years is recommended. A thesis is required for the M.R.P. degree.

Since work for the Ph.D. is considered preparatory to making creative contributions to the discipline, substantial competence in and knowledge of basic analytical and research methods will be required. Candidates may fulfill this requirement by preparation previous to entrance or by course work at Cornell, which may be in a minor subject. Candidates are also required to have some experience in research, teaching, and practice.

The Field requires Ph.D. candidates to demonstrate reading proficiency in two modern languages other than English, or reading and speaking proficiency in one language; foreign students whose native language is not English may substitute English for one of the languages. The candidate may, with the recommendation of his Special Committee, petition the Field to substitute another research technique for one of the languages.

It is recommended that students take a qualifying examination early in their program in addition to the examinations required by the Graduate School.

### Research and Study Opportunities

A research program in urban and regional studies is carried out in cooperation with the Center for Urban Development Research. Research is also conducted within the departments.

### Faculty and Specializations

- L. C. Carter, Jr.: social policy planning, national urban policy planning
- P. Clavel: planning theory and administration
- S. Czamanski: economic analysis for planning, including urban growth models, regional social accounts, regional applications of input-output analysis, location theory, housing economics, urban land economics

- A. T. Dotson: comparative planning, planning and administrative theory, politics of planning, planning and urbanization in developing countries
- W. W. Goldsmith: regional development planning and administration, economic analysis, urban and regional planning in developing countries
- C. S. Hershey: social policy planning, administrative theory, manpower, health, education and welfare programs
- M. Hugo-Brunt: history of architecture, city planning and development
- B. G. Jones: urban and regional quantitative analysis, urbanization theory, planning theory, environmental health planning, historic preservation planning
- B. Kelly: land-use regulation, development controls, the housing industry
- T. W. Mackesey: history of city planning, university planning
- K. C. Parsons: comprehensive land-use planning, institutional and urban university planning, urban design, urban renewal, history of college and university planning
- J. W. Reps: land-use regulation, planning administration, comparative planning, history of city planning in the United States
- C. Riordan: environmental health planning, comprehensive health planning, quantitative methods of economic analysis
- S. Saltzman: quantitative methods and systems analysis in planning, computers and information-processing systems
- S. W. Stein: planning and urban design within the context of comprehensive planning, housing and renewal, preservation of historic districts, enhancement of the visual assets of the city, applied aspects of planning

## Communication Arts

### Field Representative

Robert H. Crawford, 640 Stewart Avenue

### Major Subject

Communication Arts

The Field offers graduate training leading to the degree of Master of Professional Studies (Communication Arts). The program emphasizes: (1) analysis of the communication process, (2) exploration of the potential of communication techniques and technology, and (3) application of these elements to specific communications problems. Focus of the program is more on the strategic application of communication knowledge and technology, both mass media and interpersonal, than on technical competence in media operation.

For applicants whose academic records are outdated or not pertinent to the profession, evidence of superior performance in the professional field, normally for at least three years, will be considered in combination with other evidence.

All applicants are expected to have some competence in one or several areas of communication or to be willing to spend time beyond the normal degree requirements to gain this competence.

The faculty in this Field holds research interests in the following areas: press, telecommunication, international communication, communication theory, interpersonal communication, visual communication, history of the mass media, advertising, population affairs communication, and sociopolitical dimensions of the mass media.

### Faculty

- J. A. Barwind, R. D. Colle, R. H. Crawford, C. H. Freeman, H. Kim, R. D. Martin, D. M. Provine, C. C. Russell, V. R. Stephen, W. B. Ward

## Consumer Economics and Housing

### Field Representative

Marjorie Galenson, 105 Martha Van Rensselaer Hall

### Major and Minor Subjects

Consumer Economics, Housing, Family and Community Decision Making, Applied Welfare Economics and Public Policy

All candidates resident in the United States during the year preceding matriculation at Cornell must submit scores of the Graduate Record Examinations Aptitude Test with their applications.

In addition to the examinations required by the Graduate School, doctoral candidates are required to take a qualifying examination during the first year in residence. Those who complete the requirements for the master's degree before going on for the doctorate may combine the qualifying examination with the final examination for the master's degree. Except in special circumstances, students are required to take a minor outside the Field.

### Subject Descriptions

**Consumer Economics** is concerned with the welfare of the consumer in the private, semi-public, and public sectors of the economy, particularly as these operate to affect the real level of living of families. Graduate work in this major is built on a base in economic theory and statistics, and an adequate foundation in mathematics. Specific areas of specialization include: family financial management; consumer behavior in the market; consumers and the law; and theories of consumption.

**Housing** provides an interdisciplinary approach to the subject of housing. Interest in housing is defined in terms of its economic, sociological, and institutional components. Although not required for admission, a basic background in economics and sociology is necessary for the successful completion of the program. Among the possible areas of specialization are the economics of housing consumption and production; the sociology of housing; housing market analysis; and housing policy.

**Family and Community Decision Making** is concerned with the managerial behavior of families as they determine goals and allocate resources related to these goals. Emphasis is placed on the total decision event as a means of increasing the well-being of families and on the relationship among family units, local government, and other agents of public decision making. A student may emphasize either family or community decision making in his program of study.

**Applied Welfare Economics and Public Policy** focuses on the appraisal of policy issues. Welfare economics is the tool for the study of the social desirability of alternative ways of allocating resources. Special attention is given to the role of public expenditures. Policy issues covered relate to education, health, environmental problems, and urban development. Attention is given to the interrelationship of policy and planning within the larger economic-socio-political framework.

### Faculty and Specializations

L. L. Bower: production of housing, housing finance  
G. J. Byrnes: consumption economics, consumer problems, marketing  
L. C. Carter: public policy  
S. Clemhout: economic theory, welfare economics  
N. B. Conklyn: marketing, consumer economics  
C. B. Daniels: urban economics, economics of housing  
A. J. Davey: family decision making  
M. Galenson: consumption economics, consumer and the law

W. H. Gauger: leisure and time-use, public investment in recreation

A. J. Hahn: community decision making, public policy  
D. C. Knapp: public policy  
R. E. Steidl: family decision making  
E. L. Vatter: family economics, public policy  
K. E. Walker: home management, time-use research  
E. Wiegand: consumer economics  
M. Winter: housing, computer science

## Design and Environmental Analysis\*

### Field Representative

Mary E. Purchase, 201 Martha Van Rensselaer Hall

### Major and Minor Subjects

Design, Environmental Analysis

The Field offers graduate study leading to the M.A. or M.S. degree. Candidates for the Ph.D. degree in other fields may minor in either area within this Field.

Candidates desiring a design major are required to submit a portfolio directly to the Field representative. Candidates wishing to major in environmental analysis should submit the scores from either the Graduate Record Examinations Aptitude Test or the Miller Analogies Test. International students, except Canadians, are exempt from this requirement. To be considered for certain scholarships and fellowships, design majors should also submit scores from one of these tests.

Prospective majors in design should have completed a baccalaureate degree with a specialization in design, apparel design, industrial design, interior design, consumer product design, architecture, or art history.

Students wishing to specialize in the physical science aspects of environmental analysis should have preparation in one or more of the following: textiles and clothing, household equipment, chemistry, basic mathematics, or physics.

Prospective students in the social science aspects of environmental analysis should have a background in home management, social psychology, or industrial psychology, or in engineering fields such as engineering psychology or industrial engineering.

About two-thirds of the graduate students in the Field hold teaching or research assistantships. Several fellowships are available to students with specialized teaching interests or research interests in textiles and clothing, managerial problems of families, and related subjects.

### Research and Study Opportunities

The Field has well-equipped studios and workrooms, a laboratory for studying human and social factors, household equipment laboratories, an extensive costume collection, an art and environmental design gallery, and textile laboratories including a temperature and humidity controlled room and modern instruments for chemical and physical analysis.

### Faculty and Specializations

#### Design

R. P. Bartholomew: space planning, child care facilities  
A. R. Bushnell: interior space planning, consumer product design  
J. A. Carreiro: housing design, product design

\* Textiles and clothing, home management, and household equipment are included in the Field of Design and Environmental Analysis.

J. A. Koncelik: equipment design, design method, gerontology

G. C. Millican: architectural design and history, interior design

C. J. Straight: visual design

#### *Environmental Analysis*

F. D. Becker: psychology

G. J. Coates: design methods, residential environments, environments for children

N. B. Conklyn: textile marketing, environmental analysis

B. A. Lewis: textile chemistry, environmental analysis

E. R. Ostrander: social geography, personality and cognitive styles related to space and products

M. E. Purchase: household equipment; furnishings and materials in the near environment; soil prevention, analysis, and removal

R. E. Steidl: functional design criteria; management of the near environment; man-activity-environment relationships

E. E. Stout: physical aspects of textile fibers and fabrics

K. E. Walker: management of the near environment, functional design

M. V. White: science and technology of consumer textiles

## Development Sociology

### Field Representative

Philip Taietz, 137 Warren Hall

### Major and Minor Subjects

Organization Behavior and Social Action, Rural Sociology, Sociology of Development, Methods of Social Research (minor only for Ph.D.)

The Field offers training leading to the Master of Science and Doctor of Philosophy degrees, with emphasis on rural societies, on rural social systems and social organization, and on the community and regional development of nations. The program offers preparation for research, for the application of sociology in public service work, for rural development work in modernizing countries, and for college teaching.

Graduate Record Examinations scores are requested of United States and Canadian applicants and are essential for fellowship applicants. Completion of the Master's degree at an institution of recognized standing is prerequisite to acceptance in the Ph.D. program. Admission for students from outside the United States is contingent upon evidence of adequate financial support; first-year foreign students are not usually awarded a fellowship or assistantship.

Typically, a Ph.D. candidate must demonstrate proficiency in at least one of the foreign languages used for scholarly purposes or in a language appropriate to his special area of interest, such as Latin America or South Asia. Students entering the Ph.D. program must take a diagnostic examination given in conjunction with the Master's final examination for those who complete the Master's degree at Cornell and otherwise taken during the first term after entry in the Ph.D. program. Ph.D. candidates are generally expected to have directed teaching experience.

A thesis is required for the M.S. degree.

Assistantships provide part-time employment in teaching, research, or public service. The Field may recommend candidates for the Liberty Hyde Bailey research assistantships in the agricultural sciences awarded to students in a Ph.D. program. Thesis research is often conducted as a part of assistantship duties in connection with research supervised by the faculty.

### Research and Study Opportunities

For some research areas, graduate assistants who have or are willing to acquire a background in basic agricultural and biological disciplines are sought. Some Field members draw upon the resources of the Cornell University Agricultural Experiment Station for their research; recent activities under this sponsorship include studies of the community and its organization, comparative modernization and international rural development, decision making in farm families, development of American rural society, multicounty and regional development, rural manpower and farm labor, rural resource development, community structure and the aged, technological change in agriculture, rural poverty, nonfarm rural land, water resource public decision making, and agricultural and other voluntary associations. In addition to comparative studies using nations as units of analysis, investigations conducted by Field members include work in Brazil, India, Italy, Mexico, the Netherlands, Pakistan, Peru, the Philippines, and Scandinavian countries. Members of the Field participate in the Cooperative Extension Service and the International Agricultural Development programs of the New York State College of Agriculture and Life Sciences, in the Center for International Studies, and in the area programs for Latin America, South Asia, and Southeast Asia. Several of these programs have supported dissertation research overseas.

A data bank initiated in the Department of Rural Sociology provides data on domestic (United States and New York State) and international units. A Comparative Modernization Research Methods Project is sponsored jointly by the Center for International Studies and the Department of Rural Sociology. The Regional History Collection of Olin Library is acquiring an extensive set of material especially useful for the study of rural social movements and farm organizations in the United States.

### Requirements for Major Subjects

**Organization Behavior and Social Action.** For the Ph.D., a student is expected to demonstrate: (1) a thorough knowledge of theories of organization behavior, of decision making and social action, of leadership strategies, and of techniques of planned change at the organizational, community, and regional levels, with special emphasis on the rural sector of society; (2) a working knowledge of evaluation and research methods; and (3) a working knowledge of theories of social organization and social change. For the M.S. degree, a general knowledge of part (1) and part (2) is required.

**Rural Sociology.** For the Ph.D., a student is expected to demonstrate: (1) a thorough knowledge of the sociology of rural social systems and of research in this area; (2) a working knowledge of research methods; and (3) a working knowledge of theories of social organization and social change. For the M.S. degree, a general knowledge of part (1) and of (2) or (3) is required.

**Sociology of Development.** When this subject is offered as a major for the Ph.D., the student is expected to demonstrate: (1) a thorough knowledge of theories of social organization and change and an understanding of the application of these theories to planned change; (2) a knowledge of research in social organization and change, with emphasis on comparative studies of societies and their subsystems in different phases of modernization; and (3) a working knowledge of research methods. For the M.S. degree, a student is expected to demonstrate a general knowledge of part (1) and of (2) or (3).

### Faculty

W. W. Bauder, H. R. Capener, P. Clavel, J. W. Converse, G. J. Cummings, P. R. Eberts, E. C. Erickson, J. D. Francis, O. F. Larson, W. W. Reeder, J. D. Stockdale, P. Taietz, W. F. Whyte, L. K. Williams, R. M. Williams, Jr., F. W. Young

## Economics

### Field Representative

Henry Y. Wan, Jr., 470 Social Sciences Building

### Major and Minor Subjects

Econometrics and Economic Statistics, Economic Development and Planning, Economic History, Economics of Participation and Labor-Managed Systems, Economic Theory, History of Economic Thought, Industrial Organization and Control, International Economics, Labor Economics, Monetary and Financial Economics, Public Finance and Fiscal Policy

Applicants resident in the United States during the year preceding matriculation at Cornell must take the Graduate Record Examinations Aptitude Test; the GRE Advanced Test in Economics is also recommended.

Students should consult the descriptions of the Fields of Agricultural Economics, Business and Public Administration, City and Regional Planning, and Industrial and Labor Relations for other related subjects. Attention is also directed to the various international studies programs, including the Program on Comparative Economic Development.

In addition to their major and two minors, doctoral candidates will be required to demonstrate competence in economic theory, its history, and its methodology, the latter including economic statistics, and (except when the chairman of the Special Committee explicitly approves an exemption) mathematical economics.

Applications for teaching assistantships should be made directly to the Field representative of the Department of Economics.

Within his first year of residence each Ph.D. candidate in the Field of Economics must pass an oral qualifying examination in addition to the examinations required by the Graduate School.

The Field requires that each graduate student (unless specifically exempted by the Field representative) be available to serve at least one term as a teaching assistant.

### Faculty and Specializations

Econometrics and economic statistics: W. D. Evans, R. H. Frank, T. C. Liu, P. Miovic, R. Schuler, W. Taylor  
 Economic development and planning: E. T. Burton, N. R. Chen, M. G. Clark, T. E. Davis, R. T. Freeman, F. H. Golay, M. Haines, S. K. Singh, G. J. Staller, J. Vanek, H. Y. Wan, Jr.  
 Economic history: N. R. Chen, T. E. Davis, H. Fleisig, M. Haines, J. G. B. Hutchins, P. McClelland, W. Taylor  
 Economics of participation and labor-managed systems: T. E. Davis, P. Miovic, D. C. Mueller, G. J. Staller, J. Vanek  
 Economic theory: G. P. Adams, E. T. Burton, R. H. Frank, G. H. Hildebrand, A. Kats, T. C. Liu, P. Miovic, P. Pestieau, U. Possen, R. Schuler, S. Slutsky, S. C. Tsiang, J. Vanek, H. Y. Wan, Jr.  
 History of economic thought: G. P. Adams, G. H. Hildebrand  
 Industrial organization and control: E. A. Blackstone, A. E. Kahn, D. C. Mueller, W. Taylor  
 International economics: T. E. Davis, H. Fleisig, R. T. Freeman, F. H. Golay, A. Ray, G. J. Staller, S. C. Tsiang, J. Vanek, H. Y. Wan, Jr.  
 Labor economics: W. Galenson, G. H. Hildebrand  
 Monetary and financial economics: T. E. Davis, R. T. Freeman, U. Possen, S. Slutsky, S. C. Tsiang  
 Public finance and fiscal policy: E. A. Blackstone, P. Pestieau, A. Ray, R. E. Schuler, S. Slutsky

## Education

### Field Representative

João R. Egner, 103A Stone Hall

### Major and Minor Subjects

Agricultural and Occupational Education; Community Service Education; Curriculum and Instruction; Educational Administration; Educational Psychology and Measurement; Educational Research Methodology; Extension and Continuing Education; Guidance and Student Personnel Administration; History, Philosophy, and Sociology of Education; Home Economics Education; Science and Environmental Education

This Field is concerned with the scholarly study of a wide range of educational topics. Students may emphasize the improvement of teaching of a particular subject, the theory and practice of a functional educational specialization, or the application of a relevant discipline to problems of education.

All applicants for admission with majors in Education, who are residents of the United States or Canada and whose native language is English, are required to submit either a score from the Graduate Record Examinations Aptitude Test or the scores of both the Miller Analogies Test and the Doppelt Mathematical Reasoning Test. The GRE score is necessary for University fellowship applications.

Information on research assistantships, teaching assistantships, and fellowships, and application forms may be obtained from the Secretary, Field of Education, 102 Stone Hall.

The Field of Education offers two types of advanced degrees: the general degrees of M.A., M.S., and Ph.D., administered by the Graduate School, and the professional degrees of Master of Arts in Teaching and Doctor of Education, administered by the Field of Education of the Graduate School.

### Master of Arts in Teaching (M.A.T.)

The M.A.T. degree is designed for those with a baccalaureate degree planning to undertake professional preparation in the fifth year. Teaching areas for this degree include agriculture, biology, chemistry, earth science, English, French, German, home economics, mathematics, physics, Russian, Spanish, and social studies. Graduates of a teacher-training program ordinarily are not eligible for this degree.

A minimum of two regular semesters and one summer of full-time study, or two and two-fifths residence units, is required. Each candidate will be required to demonstrate teaching skill in a supervised field experience.

### M.A.T. Faculty:

B. B. Adams, J. P. Bail, J. Bereaud, A. L. Berkey, S. Blackwell, W. L. Brittain, H. R. Cushman, W. E. Drake, R. B. Fischer, H. A. Geiselman, P. Gottschalk, J. W. Kronik, H. Kufner, W. LaFeber, R. Leed, A. Lozano, M. Minot, H. Nelson, A. Nerode, J. Noblitt, J. Novak, W. Pintner, K. Rhodes, R. E. Ripple, A. Rosenberg, F. H. Stutz, F. K. T. Tom, H. L. Wardeberg

### Doctor of Education (Ed.D.)

Programs for this degree are designed to prepare the candidate for positions of leadership in the educational profession, including administrator, coordinator, curriculum specialist, extension specialist, student services specialist, supervisor, and teacher.

Applicants must have completed a minimum of three years of successful experience appropriate to their proposed



field of professional service and must show evidence of scholastic ability and other qualifications necessary for success.

A minimum of five units of residence is required beyond the Bachelor's degree, of which at least three units must be earned in residence at Cornell; two units beyond the Master's degree or its equivalent must be earned at Cornell in regular consecutive terms, except on petition. A candidate must also complete successfully a minimum of two consecutive academic terms of appropriate full-time field experience. The opportunity for the field experience is to be sought by the candidate with the advice and assistance of his Special Committee.

The program of studies must include a minimum of sixty-five credit hours beyond the Bachelor's degree, including thirty-five hours beyond the Master's degree or its equivalent.

The candidate is required to present a thesis which will give evidence of his ability to apply knowledge to a professional problem. An admission to candidacy examination and a two-part final examination are required.

For further information regarding any of the major subjects listed below, inquiries may be sent to the chairman of the division offering work in that major subject.

## Faculty and Specializations

### *Agricultural and Occupational Education*

W. E. Drake, chairman; J. P. Bail, A. L. Berkey, H. R. Cushman, F. K. T. Tom

The graduate program in agricultural and occupational education prepares the student for positions in teaching, research, supervision, and administration in public schools, technical schools, and colleges and universities, as well as for specialized positions as teacher-educators and administrators in agricultural and occupational education. Students may concentrate on administration, curriculum, research, supervision, or teacher education. Current research interests are in the areas of improvement of college teaching, assessment of inservice needs, curriculum development, task analysis, agricultural images, and administration of vocational education programs.

### *Community Service Education*

I. Lazar, chairman; D. Barr, R. Babcock, S. Blackwell, H. Brenden, I. I. Imbler, M. E. Minot, B. J. Mueller, H. Y. Nelson, L. A. Noble, K. Rhodes, A. Sorenson, J. Wright

This subject focuses on the analysis of a wide range of community services such as education, social services, health systems intended to help people maintain or improve the quality of everyday life. The aim of such analysis is to identify the skills required by human service professionals and auxiliary workers, to design appropriate personnel education programs, and to design methods of coordinating and evaluating human services. All students have opportunity for field experience. Current research interests include a study of: development and evaluation of a community service education center where a combination of theory and field experience is made available to students and of a human services training program where social agencies, schools, and colleges are working together to strengthen the paraprofessional-professional team of workers; the effectiveness of paraprofessionals in community service working with low income families; education and comparative family development using the concepts of individual family and community differentiation; the effects of structural and aggregated predictor variables on adolescent anomie and vocational planning in rural, suburban, and urban high schools.

### *Curriculum and Instruction*

H. L. Wardeberg, chairman; R. L. Bruce, W. E. Drake, H. A. Geiselman, D. B. Gowin, M. E. Minot, J. D. Novak, W. J. Pauk, K. Rhodes, R. E. Ripple, V. N. Rockcastle

The program is devoted to study of the total curriculum and its relation to instruction at any level. Research includes analysis of teaching behavior, investigation of cognitive processes in instruction, theories of curriculum organization, and development of instructional materials. The M.A. and M.S. degree programs are available only to persons with appropriate experience. The M.A.T. degree is available to those with strong preparation in selected subject matter fields.

### *Educational Administration*

L. B. Hixon, chairman; J. P. Bail, R. L. Bruce, J. R. Egner, E. J. Haller, H. L. Wardeberg, J. Wilcox

For a major in this subject, the candidate must demonstrate knowledge of: (a) theoretical concepts of administration, (b) the basic disciplines which deal with the relationships between individuals and groups within an organization and between organizations, (c) research in education administration, and (d) environmental factors which influence the education enterprise.

### *Educational Psychology and Measurement*

R. E. Ripple, chairman; H. G. Andrus, M. D. Glock, H. Levin, G. W. McConkie, J. Millman

A major in this subject provides students with a strong background in both research psychology and education. Individual programs are structured to prepare students to conduct research on psychological problems important to education practice. Extensive research experience carried out in close contact with faculty members is emphasized.

Current research deals with cognitive processes, such as reading, problem solving, learning and memory, as well as noncognitive outcomes of education.

### *Educational Research Methodology*

J. Millman, chairman; R. L. Bruce, R. B. Darlington, D. B. Gowin, K. Strike

The task of educational research methodology is to appraise scientifically generative ideas, methods, products, and values by describing and explaining them, by identifying their limitations and advantages, by clarifying underlying presuppositions, and by projecting judgments about the likely consequences of their use in the context of educational research. Students who major in this subject are those who enjoy mathematics or the philosophy of science and who are interested in applying analytical methods to problems of education.

Programs almost always include techniques of measurement, applied statistics, methods of program evaluation, and conceptual problems in educational inquiry.

### *Extension and Continuing Education*

J. Paul Leagans, chairman; G. J. Broadwell, R. L. Bruce, I. I. Imbler

The curriculum is designed to prepare administrators, supervisors, training specialists, and research scholars for two-year and four-year colleges and universities, extension education systems, public schools, and other agencies engaged in the continuing education of adults, both in the United States and abroad.

Among faculty and student teaching and research interests are the structure of extension and other continuing education organizations for adults, the design of programs, communication processes, leadership of adult education agencies, staffing, professional training, and evaluation of programs.

*Guidance and Student Personnel Administration*  
D. E. Hedlund, chairman; H. G. Andrus, K. M. Moore

This major is appropriate for students who wish to prepare for college student personnel administration, college counseling, and counselor education. The major represents an interdisciplinary behavioral science study of the organization and administration of higher education, student development, psychological counseling, and intervention skills to effect change on an individual, group, or organizational level.

*History, Philosophy, and Sociology of Education*  
D. B. Gowin, chairman; E. J. Haller, K. A. Strike, F. H. Stutz

All doctoral students will specialize in one or more of the following four areas: history of education, philosophy of education, sociology of education, and comparative education.

Conceptual analysis is done on educational aims, structure of knowledge, curriculum and instruction, policy and governance, and problems of educational practice. Systematic study is done on major philosophers of education, philosophy of mind, political philosophy, behavioral science, and educational research.

History of education emphasizes American education, comparative and international education, higher education, and recent trends toward innovative education programs.

Sociology of education studies the social structure of schools and classrooms, institutional allocation of talent, occupations, administrative science, and organizations.

*Home Economics Education*  
I. Lazar, chairman; S. Blackwell, M. E. Minot, B. J. Mueller, H. Y. Nelson, L. A. Noble, K. Rhodes, A. Sorenson

The major focuses on the analysis of education as an instrument for effective change, with special emphasis on improving the quality of everyday life. Central to the program is study of the nature of change—describing, predicting, effecting, and measuring it. Students interested in becoming teacher educators have opportunity to enroll in a planned sequence of courses and field experiences, culminating in a practicum in which they assume responsibility for a student field experience. Research currently under way includes: evaluation of programs in homemaking and consumer education designed for socio-economically disadvantaged adults; the development and evaluation of programs to prepare teachers of home economics for disadvantaged urban areas; evaluation of training programs for paraprofessionals in the human services; and cross-cultural studies relating educational and sociological factors to individual behavior and family development.

*Science and Environmental Education*  
J. D. Novak, chairman; W. F. Brautigan, R. B. Fischer, V. N. Rockcastle

Persons with an interest in science and environmental education will find programs arranged to meet requirements for Master's or doctoral degrees in either of two areas: (1) science teaching, science supervision, science curriculum development, teacher preparation and research at elementary, secondary, and college levels; (2) environmental education programs leading to professional positions as interpretive naturalists, directors of interpretive nature centers, or conservation education specialists with school systems, state departments, and other private or governmental agencies.

*Other Faculty*  
B. B. Adams, A. L. Baldwin, W. L. Brittain, R. E. Doherty, J. Failing, F. F. Foltman, J. S. Harding, B. Nichols

## Government

### Field Representative

Douglas E. Ashford, 132 McGraw Hall

### Major and Minor Subjects

American Politics, Comparative Politics, Political Thought, International Relations

### Minor Subject

Methodology of Politics

The Field asks applicants to submit scores of the Graduate Record Examinations Aptitude and Advanced Tests.

The Field of Government asks its students to acquire: (1) a thorough knowledge of the discipline, including substantial theoretical, conceptional, and substantive competence in a major interest, and a solid foundation in two minor subjects; (2) to provide a clear demonstration of the methodological, linguistic or other skills needed to conduct scholarly and original research; (3) to acquire at least one term's experience as a teaching assistant. Where students have not taken equivalent courses previously, they are expected to take three of the four Field Seminars in the major subjects. Students are normally admitted only at the beginning of the academic year.

Early in the first semester, the new graduate student meets with the director of graduate studies and several faculty to discuss the first year's program. By mid-year the student should form a Special Committee. In the second term, the faculty conducts a review of each student's progress, and where considered necessary an oral qualifying examination may be held.

By the end of the third year of residence, and sooner if possible, the student is expected to have taken the admission to candidacy examination. The examination is given in two parts: written examinations in each of the subjects prepared by the Field and an oral examination conducted by the Special Committee. The written examinations are normally given three times a year; the student may opt to take two written examinations at one time and the third later, providing this is done consecutively. Except under special circumstances, the Field limits support to four years. Both the admission to candidacy examination and the approval of thesis examination are open to all faculty members of the Field.

Students are normally not admitted to pursue only the master's degree. The master's degree is awarded after one year of course work of high quality and the presentation of a master's thesis. Where work is not of high quality, the Field may require a third term of course work.

For both the Ph.D. and M.A. programs, the student is asked to prepare a statement of intellectual goals, showing the relationship of major and minor subjects, when a Special Committee is formed. At the admission to candidacy examination this statement is to be supplemented with a thesis proposal, outlining the hypotheses, data, methods, and resources needed to successfully complete his dissertation.

All fellowships in the Field of Government are awarded through the Graduate School competition.

### Interdisciplinary Programs

Students are encouraged to take advantage of the numerous interdisciplinary programs including: the Program on Science, Technology, and Society; the Structural Change Program, the Rural Development Program, and the Peace Studies Group of the Center for International Studies; the Public Policy Group

associated with the Graduate School of Business and Public Administration; and the foreign area programs for Latin America, Southeast Asia, China and the Soviet Union. The Field is also closely involved with the Field of Public Policy.

### Faculty and Specializations

#### *American Politics*

- H. Alker: psychology and politics
- D. J. Danelski: public law and judicial behavior
- A. T. Dotson: public administration, public policy
- E. Eisenach: theory of liberalism
- D. Karns: public opinion and foreign policy
- T. Lowi: presidency, parties, American liberalism
- M. Nadel: intergovernmental relationships, bureaucracy, organization, public policy
- G. H. Quester: defense policy
- R. N. Rosecrance: national security policy
- D. E. Van Houweling: urban politics
- R. Weissberg: political socialization and public opinion

#### *Comparative Politics*

- B. R. O'G. Anderson: Southeast Asia, military elites in the Third World
- D. E. Ashford: comparative local politics, nationalism, political development, public policy
- P. H. Auerbach: France, comparative socialization, national planning
- A. T. Dotson: development administration
- L. G. E. Edmondson: Africa, comparative race relations, Black ideologies
- M. Einaudi: France and Italy, public corporations and planning
- M. J. Esman: comparative public administration and political development, public policy
- G. McT. Kahin: Southeast Asia
- E. Kenworthy: Latin America, political development
- D. P. Mozingo: China, comparative revolutions
- T. J. Pempel: Japan, political development
- G. H. Quester: comparative foreign policies
- M. Rush: Soviet Union, comparative communism, political succession
- S. Tarrow: France, Italy, parties, and elections
- N. T. Uphoff: political economy, West Africa, development theory, public policy

#### *Political Thought*

- W. J. Dannhauser: Hegel, Marx, Nietzsche
- M. Einaudi: modern European ideologies
- E. Eisenach: Hobbes, Locke, and the liberal tradition, legal theory
- D. Karns: mathematical models of politics
- I. Kramnick: British radicalism, intellectual history

#### *International Relations*

- L. G. E. Edmondson: international organizations
- M. J. Esman: foreign aid, international flows of technology
- G. McT. Kahin: foreign relations of Southeast Asia
- D. Karns: quantitative analysis of international exchanges
- D. P. Mozingo: foreign relations of China
- G. H. Quester: foreign policy processes, arms control and disarmament
- R. N. Rosecrance: international relations theory, defense strategies, foreign policy
- M. Rush: foreign relations of the Soviet Union
- L. Scheinman: international organization and law

#### *Methodology of Politics*

- H. Alker: psychological testing and attitudinal change
- D. E. Ashford: cross-national comparison, survey research, and political behavior
- D. J. Danelski: quantitative judicial behavior
- D. Karns: computer programming and mathematics
- S. Tarrow: voting behavior and electoral studies
- D. Van Houweling: computer programming and simulation

R. Weissberg: socialization, voting behavior, and survey research

### Hotel Administration

#### Field Representative

Stanley W. Davis, Statler Hall

#### Major and Minor Subjects

Hotel Administration, Hotel Accounting

Graduate work in this Field is open only to those who have completed in full the requirements for the undergraduate degree in the School of Hotel Administration at Cornell.

Students holding bachelor's degrees in the liberal arts or in general business administration who wish a program in hotel administration normally enroll in the undergraduate division.

Candidates for the master's degree may select either hotel administration, or hotel accounting as their major subject; for the Ph.D. the major subject must be hotel administration. Candidates for the Ph.D. degree must demonstrate reading ability in one language other than their native language.

#### Faculty

R. A. Beck, P. R. Broten, V. A. Christian, J. J. Clark, S. W. Davis, D. D. Dunn, M. H. Ericson, W. H. Kaven, H. J. Recknagel

### Human Development and Family Studies

#### Field Representative

Edward C. Devereux, Jr., Martha Van Rensselaer Hall

#### Major and Minor Subjects

Child Development, Child and Family Psychopathology, Cognitive Development, Early Childhood Education (major for Master's only), Family Relationships, Social and Personality Development

Most successful applicants have undergraduate majors in psychology, sociology, child development, or family relationships, but students of high ability may be admitted regardless of undergraduate background. All applicants are required to submit their scores on the Graduate Record Examinations Aptitude test.

The Field attempts to provide full financial support during the academic year for each graduate student who requests it, provided his work is satisfactory. This support is primarily through research and teaching assistantships which are regarded as an integral part of graduate training. Additional support in the form of twelve NIMH Traineeships and five cognitive traineeships is also available.

The principal aim of the graduate program is to train students as research workers and college teachers. It does not prepare students to be clinical psychologists, school psychologists, or family life counselors.

All students are expected to acquire a basic background in the behavioral sciences and to master a broad base of knowledge of human development and of the family as a social system.

The degrees offered are the M.A., M.S., and Ph.D. One semester of graduate-level training in statistics is required of all master's degree candidates, and two semesters of all Ph.D. candidates. Some teaching experience will be required for degree candidates. Master's degree programs ordinarily require one and one-half to two years for completion; doctoral programs, about four years.

### Research and Study Opportunities

The Field cooperates with the Field of Psychology in sponsoring a joint program in developmental studies.

A major activity of the Field is the Research and Development Program in Early Childhood Education, one of seven such programs at different universities financed by the United States Office of Education.

Students who elect Child and Family Psychopathology as a subject have opportunities to spend one year doing field work in several clinical centers in metropolitan areas. They may concentrate in pediatric psychology, and spend their field year at the Pediatrics Department of the Cornell Medical School in New York City.

Present research projects of the Field are in the following areas: cross-cultural studies in socialization, the family in poverty, social interaction of preschool children, family interaction and the adolescent personality, children's concepts of personal attributes, adult-child interaction in the home, social behavior of children in small groups, drawing and painting of children and adolescents, early school learning, the development of structure in language, instructional strategies in early language training, nursery school curriculum research and development, effects of story reading on two-year-olds, analysis of home environment and parent intervention procedures, visual development in early infancy, emotional and social adjustment of the child to preschool programs, cognitive and affective behavior in infancy, and observational studies of mother-child interaction.

### Faculty

A. L. Baldwin, C. P. Baldwin, H. T. M. Bayer, W. L. Brittain, U. Bronfenbrenner, J. C. Condry, E. C. Devereux, Jr., J. Doris, H. Feldman, E. J. Gibson, H. Ginsburg, J. S. Harding, T. Hertz, J. E. Knitzer, W. W. Lambert, L. C. Lee, E. Lenneberg, H. Levin, A. McIntyre, M. Potts, H. N. Ricciuti, R. R. Rodgers, B. Rosen, D. Roy, G. Streib, J. M. Stycos, G. J. Suci, P. Taietz, N. Tavuchis

## Industrial and Labor Relations

### Field Representative

Lawrence K. Williams, 101 Ives Hall

### Major and Minor Subjects

Collective Bargaining, Labor Law, and Labor Movements; Economic and Social Statistics; International and Comparative Labor Relations; Labor Economics and Income Security; Manpower Studies; Organizational Behavior

### Minor Subject Only

Industrial and Labor Relations Problems (available only for students majoring in other Fields)

Applicants whose native language is English are required to take the aptitude portion of the Graduate Record Examinations. For admission to the Ph.D. program, a master's degree or its equivalent is usually required; direct admission is possible in cases of exceptional promise.

The Master of Industrial and Labor Relations program is designed to provide broad coverage within the Field and some opportunity for advanced specialized work. It requires four semesters, and a total of fourteen courses, nine of which are required. The requirements for this degree are fulfilled by satisfactory performance in these courses.

The final examination for the Master of Science degree includes a test of subject matter competence in the major

and minor subjects and a defense of the master's thesis. The examination is both written and oral.

The Field may administer a preliminary examination prior to admitting students to the doctoral program. The acquisition of teaching experience, during study for the doctorate, is required.

### Faculty and Specializations

*Collective Bargaining, Labor Law, and Labor Movements*  
D. E. Cullen, chairman; G. W. Brooks, R. E. Doherty, F. Freilicher, J. A. Gross, K. L. Hanslowe, V. H. Jensen, M. R. Konvitz, A. G. Korman, D. B. Lipsky, J. T. McKelvey, J. O. Morris, M. F. Neufeld, J. P. Windmuller, B. Yaffe

Faculty members specialize in the following three areas: (1) the study of the legal framework within which labor-management relations systems in the United States have developed; (2) the study of the history and structure of various components of the American trade union movement at the local, national, and confederation levels; and (3) the study of institutions, practices, and principles relevant to understanding how interested parties resolve conflicts over the conditions of the labor contract.

### *Economic and Social Statistics*

P. J. McCarthy, chairman; I. Blumen, W. D. Evans, I. Francis

Faculty members are mathematical statisticians interested in the application of their area of expertise to the social studies. They offer students an opportunity to study how the tools of mathematical statistics help in describing and analyzing socioeconomic phenomena and how various hypotheses can be tested quantitatively.

### *International and Comparative Labor Relations*

W. Galenson, chairman; M. G. Clark, G. H. Hildebrand, M. F. Neufeld, W. F. Whyte, J. P. Windmuller

This area of study deals with two major problems; a comparative analysis of the ways in which industrial societies other than the United States handle labor market problems; and the study of social institutions and economic conditions that facilitate or impede development in developing countries.

### *Labor Economics and Income Security*

R. L. Aronson, chairman; M. G. Clark, R. H. Ferguson, W. Galenson, G. H. Hildebrand, D. M. MacIntyre, L. J. Perl, R. L. Raimon, F. Slavick, V. L. Stoikov

Scholarly interests of students in labor economics and income security lie primarily in two directions. Some seek to generalize about the ways in which movements of prices, wages, and workers are related and to study the mechanisms of various labor markets. Others examine private and/or public programs designed to insure the working population against those risks of living in an industrial society which can be expressed in money terms.

### *Manpower Studies*

F. B. Miller, chairman; F. F. Foltman, W. W. Frank, W. L. Hodges, R. F. Risley, V. L. Stoikov, W. J. Wasmuth, W. B. Wolf

Manpower management has two main facets. First, the conventional study of the personnel function is directed at understanding how the single employing organization deals with its human resources. Second, the study of manpower supply and training problems at the community and national levels is increasingly a matter of critical public policy.

### *Organizational Behavior*

N. A. Rosen, chairman; H. E. Aldrich, B. R. Brown, G. Gordon, L. W. Gruenfeld, M. W. Meyer, H. M. Trice, W. F. Whyte, L. K. Williams

This Department is staffed by behavioral scientists, including psychologists, social psychologists, sociologists,



and cultural anthropologists. Opportunity is offered for study of the nature of industrial society as a context for complex work organizations, the study of such organizations *per se*, or the study of the behavior of small groups and individuals which are components of such organizations.

## International Agricultural Development

### Field Representative

Kenneth L. Turk, 102 Roberts Hall

### Minor Subject

International Agricultural Development

This Field is intended primarily for the student preparing for service in international agriculture and draws from several disciplines to assist the student in understanding the special conditions and problems of newly developing economies. While this minor, which is intended for international students as well as for those from the United States, is planned specifically for students majoring in one of the graduate Fields in agriculture and life sciences, other qualified students are welcome. A student minoring in this Field is encouraged to become proficient in that language which will most likely be useful in his area of service.

A student may not minor in this Field if he is minoring in one of the area programs, such as Asian Studies or Latin American Studies, and he may not select a professor for this minor who also serves on the graduate faculty in his major Field.

### Faculty

D. E. Ashford, S. L. Barraclough, F. T. Bent, C. W. Boothroyd, P. A. Buck, F. B. Cady, H. R. Capener, M. G. Cline, R. Colle, H. E. Conklin, J. W. Converse, R. H. Crawford, L. V. Crowder, T. E. Davis, M. Drosdoff, E. C. Erickson, M. J. Esman, R. H. Fox (at Puerto Rico), D. K. Freebairn, F. H. Golay, R. F. Holland, W. K. Jordan, W. C. Kelly, G. C. Kent, R. P. Korf, F. V. Kosikowski, M. C. Latham, D. J. Lathwell, J. P. Leagans, G. Levine, J. K. Loosli, H. A. MacDonald, J. G. Matthyse, R. E. McDowell, J. W. Mellor, P. A. Minges, H. M. Munger, R. B. Musgrave, T. T. Poleman, Jr., K. L. Robinson, J. L. Saunders, M. L. Scott, D. G. Sisler, R. M. Smock, K. H. Steinkraus (at Geneva), E. L. Stone, Jr., R. D. Sweet, H. D. Thurston, F. K. T. Tom, G. W. Trimmer, K. L. Turk, N. Uphoff, D. H. Wallace, F. W. Young

## Latin American Studies

### Field Representative

John V. Murra, 190E Social Sciences Building

### Minor Subject

Latin American Studies

Latin American Studies is a *minor* field of concentration at Cornell; consequently a prospective student must first be admitted to a *major* Field of the Graduate School. Subsequent to admission, a student elects a minor in Latin American Studies by inviting a member of the graduate faculty who represents this area to sit on his Special Committee.

Direct field research experience provides opportunity to investigate a problem in Latin America by utilizing the tools of the major discipline and usually constitutes the immediate data on which the Ph.D. or Master's thesis is based. Faculty members from various academic Fields

are currently engaged in research or field work in many Latin American countries and are usually able to counsel scholars who are comparatively new to the area.

### Faculty

F. B. Agard, S. Barraclough, J. W. Converse, L. V. Crowder, D. Davidson, T. E. Davis, M. Drosdoff, D. K. Freebairn, R. K. Goldsen, W. W. Goldsmith, R. Gonzalez, T. Gregor, J. S. Henderson, J. A. Kahl, E. Kenworthy, L. Kerr, T. F. Lynch, R. E. McDowell, J. V. Murra, T. Poleman, G. Read, W. W. Rogers, B. C. Rosen, J. F. Scott, D. F. Solá, W. A. Stini, J. M. Stycos, R. B. Thomas, H. D. Thurston, W. F. Whyte, L. K. Williams, F. W. Young

## Law

### Field Representative

John J. Barceló, 404 Myron Taylor Hall

### Major and Minor Subject

Law

The Master of Laws (LL.M.) and the Doctor of the Science of Law (J.S.D.) degrees are conferred. The former is intended for the student who desires to increase his knowledge of law by work in a specialized field. The latter is intended for the student who desires to become a legal scholar and to pursue original investigations into the function, administration, history, and progress of law.

The minimum residence requirement is two full semesters, but completion of the LL.M. program usually requires one summer in addition, and the J.S.D. program normally requires three to four semesters. Longer periods may be required. Candidates for either degree are ordinarily expected to concentrate on one legal field and to do a substantial amount of work in at least one other field.

Students who meet the requirements for admission to the Graduate School's Division of Law but who do not wish to become candidates for a degree may, at the discretion of the faculty, be admitted as nondegree graduate students.

Applicants for admission for an LL.M. or J.S.D. degree are expected to hold both a baccalaureate degree and a degree of Doctor of Law (J.D.) or a degree of equivalent rank from an approved law school. An applicant for admission for a J.S.D. degree must also have had professional practice or experience in teaching or advanced research. Applications should state in as much detail as possible the objective for which the applicant wishes to do advanced graduate work and the particular fields of study that he wishes to pursue.

Applicants from other countries can be considered for degree candidacy only if they have completed with distinction all the studies necessary for admission or licensing for the practice of law in their own country.

For further details, see the *Announcement of the Law School*. Each candidate must pass examinations in courses taken for credit, an oral examination, and any other examinations required by his Special Committee.

A thesis or its equivalent is required of LL.M. candidates and a scholarly dissertation of J.S.D. candidates.

Special research and study opportunities exist at Cornell in city and regional planning, comparative law, commercial law, copyright and trademark law, corporation law, environmental law, government contracts, industrial and labor relations, international legal studies, legislation, and property law. See also the description of the International Legal Studies Program in the *Announcement of the Law School*.

**Faculty**

R. A. Anthony, J. J. Barceló, H. Bitner, W. D. Curtiss, W. T. Dean, W. R. Forrester, H. A. Freeman, K. L. Hanslowe, H. G. Henn, W. E. Hogan, M. R. Konvitz, J. W. McDonald, P. W. Martin, W. E. Oberer, R. S. Pasley, N. Penney, D. L. Ratner, E. F. Roberts, Jr., F. F. Rossi, R. B. Schlesinger, R. S. Summers, G. Thoron, E. N. Warren, H. L. Warren

**Linguistics****Field Representative**

Frederick B. Agard, 204A Rand Hall

**Major Subject**

General Linguistics

**Minor Subject**

Sociolinguistics

A candidate for the M.A. degree is required to demonstrate a reading knowledge of one language other than his native language. The Ph.D. candidate is required to demonstrate a reading knowledge of two languages other than his native language, of which at least one must be English, German, or Russian.

For the Ph.D., a qualifying examination, taken at the end of the first semester of residence, is required, in addition to the examinations required by the Graduate School.

A well-qualified student with a good background in linguistics can complete an M.A. degree in one year and a Ph.D. degree in three years after the B.A. It is not required that an M.A. degree be earned on the way to a Ph.D. degree.

Teaching experience is a requirement for Ph.D. candidates.

A broad scope of offerings in both pure and applied linguistics is available, including not only courses in general linguistics, but also language-specific courses in East Asian linguistics (China, Japan), South Asian linguistics (Ceylon, India, Pakistan), and Southeast Asian linguistics (Burma, Indonesia, Philippines, Thailand, Vietnam).

Specialization in linguistics is offered by several Fields in the Graduate School: Asian Studies has East Asian linguistics, South Asian linguistics and Southeast Asian linguistics as minor subjects. There is a minor in Indo-European linguistics in the Field of Classics. A minor in English linguistics may be taken in the Field of English Language and Literature. The Field of Germanic Studies has majors and minors in Germanic linguistics. Under Romance Linguistics, majors and minors are offered in French, Italian, Romance, and Spanish linguistics. Majors and minors are offered by the Field of Slavic Linguistics. All of these offerings will be found in this *Announcement* under the headings for the various Fields.

**Faculty and Specializations**

F. B. Agard: Romance linguistics, Portuguese, Rumanian  
L. H. Babby: Slavic linguistics  
N. C. Bodman: Chinese and Sino-Tibetan linguistics  
R. Brecht: Slavic linguistics  
J. M. Echols: Malayo-Polynesian linguistics  
C. E. Elliott: English linguistics, Hindi  
J. W. Gair: general linguistics, South Asian linguistics, Sinhalese  
J. E. Grimes: general linguistics, indigenous languages of the Americas, computational linguistics  
R. A. Hall, Jr.: comparative Romance linguistics, history of Italian language and literature, pidgin and creole languages

B. Hathaway: English linguistics  
C. F. Hockett: anthropological linguistics  
F. E. Huffman: Vietnamese, Cambodian, Thai  
R. B. Jones, Jr.: descriptive and comparative linguistics of Southeast Asia  
E. H. Jorden: Japanese linguistics, language pedagogy  
R. E. Kaske: English linguistics  
G. B. Kelley: Dravidian, computational, general linguistics, Sociolinguistics  
H. L. Kufner: Germanic linguistics  
R. L. Leed: Slavic linguistics, general linguistics  
P. Lowe, Jr.: Germanic linguistics  
J. McCoy: Japanese and Chinese linguistics, Chinese dialects  
G. M. Messing: Classical linguistics  
J. S. Noblitt: Romance linguistics, programmed learning  
L. W. Sangster: French linguistics  
D. F. Solá: Spanish linguistics, Quechua  
F. van Coetsem: Germanic linguistics  
J. U. Wolff: Indonesian and Philippine linguistics

**Psychology**

(Please see p. 61.)

**Public Policy****Field Representative**

Norman Uphoff, Social Sciences Building

**Minor Subject**

Public Policy

Questions of public choice and policy applications are very real concerns within many disciplines, reflecting changes within our society. The complexities and interdependencies of the more industrialized societies and the inequities and immobilities in less developed countries pose problems more difficult and urgent than ever before. They require multidisciplinary analysis for which existing graduate education does not necessarily prepare a graduate student. The minor Field of Public Policy is designed to complement study in major fields such as government, economics, administration, anthropology, sociology, planning, ecology, engineering, industrial relations, or a physical science. The Field contributes to a linking of analytical skills and substantive knowledge, of positive and normative analysis, and of public choice and public action.

Students choosing this as a minor Field will usually write a dissertation bearing on some aspect of public policy. Seminars and course work, as well as directed and independent reading will be organized to give the students multidisciplinary depth to the thesis and to subsequent teaching, research, and practice.

**Faculty**

H. E. Aldrich, D. J. Allee, D. E. Ashford, F. T. Bent, P. L. Bereano, E. A. Blackstone, L. C. Carter, Jr., L. D. Chapman, S. Clemhout, E. T. Cranch, T. E. Davis, A. T. Dotson, P. A. Eberts, E. C. Erickson, M. J. Esman, L. M. Falkson, E. S. Flash, Jr., W. W. Goldsmith, A. J. Hahn, C. S. Hershey, J. G. B. Hutchins, R. J. Kalter, O. F. Larson, F. A. Long, D. P. Loucks, J. W. Mellor, D. C. Mueller, M. V. Nadel, L. J. Perl, G. H. Quester, R. Rosecrance, R. Schramm, J. D. Stockdale, R. Tollison, N. Uphoff, E. L. Vatter, T. D. Willett

**Regional Science****Field Representative**

Stanislaw Czamanski, 112 W. Sibley Hall

## Major and Minor Subject

### Regional Science

All degree candidates resident in the United States during the year preceding registration in the Graduate School must take the Graduate Record Examinations Aptitude Test. There are no other fixed admission requirements. For admission into the postdoctoral program, publications, grades, class standing, and letters of recommendation must collectively indicate superior ability for creative research.

The Ph.D. program is designed to provide (1) a thorough understanding of the underlying theory of location and spatial interaction of human activities in their economic, social, and political contexts, and (2) a mastery of techniques of analysis of regional systems designed to develop guidelines for public policy and private decisions. Heavy emphasis is placed upon mathematical models and quantitative methods. The student is fully exposed to the existing and newly developing social science theory which directly relates to the multidisciplinary approach of regional science. The course offerings focus on the socioeconomic aspects of the physical environment and on the spatial aspects of socioeconomic systems. Since work for the Ph.D. is considered preparatory to making creative contributions to the discipline, substantial competence in basic analytical and research methods will be required. Applicants are expected to have substantial preparation prior to entrance which may be supplemented by course work at Cornell.

Ph.D. candidates are required to demonstrate reading proficiency in two modern languages other than English, or reading and speaking proficiency in one language; foreign students whose native language is not English may substitute English for one of the languages. The candidate may petition to substitute advanced training in a relevant research technique for one of the languages. It is recommended that students take a qualifying examination early in their program.

The primary objective of the postdoctoral program is to deepen our understanding of complex urban, regional, and spatial phenomena by: (1) bringing together within the Regional Science group scholars with diverse backgrounds in the social science, design, engineering, and related fields; (2) encouraging each scholar to probe areas of interest and challenge in unprogrammed independent ways; (3) establishing active, working relationships with one or more research teams at Cornell; and (4) exchanging ideas in informal regional science seminars held once or twice a week. It is expected that each postdoctoral scholar will undertake research of such a high quality as to lead to publication in scholarly journals such as the *Journal of Regional Science*.

### Faculty and Specializations

- D. Allee: resource economics, regional economics, regional development planning
- S. Czamanski: economic analysis for planning, including: urban growth models, regional social accounts, regional applications of input-output analysis, location theory, housing economics
- D. Evans: economic and social statistics, input-output analysis
- W. Goldsmith: regional development planning and administration, economic analysis, urban and regional planning in developing countries
- W. Isard: regional input-output analysis, gravity models, location theory, general social science theory
- B. G. Jones: urban and regional quantitative analysis, urbanization theory, planning theory, environmental health planning
- R. Kalter: economic evaluation of public investment, water projects, recreation, environmental quality

- T. C. Liu: econometrics, economic statistics
- C. Riordan: environmental health planning, comprehensive health planning, quantitative methods of economic analysis
- S. Saltzman: quantitative methods and systems analysis in planning, computers and information-processing systems

## Sociology

### Field Representative

Donald P. Hayes, Social Sciences Building

### Major Subjects

General Sociology, Demography-Ecology, Research Methodology, Social Organization and Change, Social Psychology

### Minor Subjects

Demography-Ecology, Research Methodology, Social Organization and Change, Social Psychology

Candidates for the Ph.D. degree are required to have a general background in sociology. Students who enter the program from other disciplines should correct deficiencies in their first year within the program. The entering student should have some knowledge of the basic concepts and applications of quantitative analysis. Graduate Record Examinations scores are required. All inquiries for admission and financial aid should be made directly to the Field representative. The prospective student is advised to consult the brochure *Sociology at Cornell*, which may be obtained by writing to the Field representative.

The language requirement for the Ph.D. degree is set by the student's Special Committee. In general, proficiency in one modern foreign language other than his native tongue is expected. Upon the unanimous approval of the student's Special Committee, a specified level of preparation in mathematics may be substituted. A list of procedures for meeting the language requirement is available from the Field representative.

M.A. candidates major in general sociology, which covers the four specific subjects of social organization and change, research methodology, demography-ecology, and social psychology.

Students in the Ph.D. program may register in general sociology initially, but must select one of the other four major subjects before taking the admission to candidacy examination.

All students in the Ph.D. program are required to have one year of directed teaching experience at Cornell unless specifically exempted. Typically, this teaching practicum would be scheduled for the second year of residence. In addition, students in the M.A. and Ph.D. programs are expected to prepare themselves to undertake research both through formal course work and through exposure to the ongoing research activities of the faculty.

Candidates in full-time residence are normally expected to complete the Ph.D. degree within two to three years after completion of the M.A. degree. A diagnostic qualifying examination may be held at the request of the student or his Special Committee.

### Subject Descriptions

**Demography-Ecology.** This major requires (1) a thorough knowledge of demographic and ecological theory and substantive research; (2) a thorough knowledge of the techniques of demographic and ecological data collection and analysis; (3) a working knowledge of the theory and methods of social organization and change.

**Research Methodology.** This major requires (1) a detailed knowledge of the logic of science; (2) a general knowledge of research design, data collection techniques, and analytic procedure; (3) a working knowledge of the theory of social organization and change; (4) a concentration of study in one of the areas listed in (1) and (2).

**Social Organization and Change.** This major requires (1) a thorough knowledge of theories of and research in social organization and change; (2) a working knowledge of research methods; (3) a detailed knowledge of two subfields in social organization.

**Social Psychology.** This major requires (1) a thorough knowledge of social psychological theory and research; (2) a working knowledge of the methodology of social psychological research; (3) a working knowledge of psychology, sociology, and relevant aspects of other related disciplines; and (4) a detailed knowledge of some specialized aspect of social psychology.

### Faculty and Specializations

Many of the investigations of the faculty have been done in cross-cultural settings: Africa, Latin America, and Europe. Staff members also participate in the Center for International Studies and various area study programs.

Comparative: R. K. Goldsen, J. A. Kahl, W. W. Lambert, R. M. Williams, Jr.  
Demography: P. Chi, J. M. Stycos  
Family: G. F. Streib, J. M. Stycos, N. Tavuchis  
Formal and complex organizations: G. Gordon, M. Meyer, W. F. Whyte  
Mathematical: N. Henry, R. McGinnis  
Methods of statistics: P. Chi, R. K. Goldsen, N. Henry, R. McGinnis  
Medical: T. Wan  
Social organization and change: M. Naditch, L. Reissman, B. C. Rosen, G. F. Streib, W. F. Whyte, R. M. Williams, Jr.  
Social psychology: H. Alker, D. P. Hayes, S. Jones, W. W. Lambert, J. L. Laws, M. Naditch, D. Regan, B. C. Rosen, G. F. Streib  
Stratification and mobility: J. A. Kahl, R. McGinnis, N. Tavuchis  
Urban: L. Reissman, G. F. Streib

## Statistics

### Field Representative

Isadore Blumen, 360 Ives Hall

### Major Subject

Statistics

Applicants should ordinarily have obtained the approximate equivalent of an undergraduate major in mathematics. It is strongly recommended that applicants resident in the United States during the year before entering the Graduate School present scores on the Graduate Record Examinations Aptitude Test.

A candidate for the Ph.D. degree must demonstrate reading ability in French, German, or Russian.

In addition to the examinations required by the Graduate School, students in the Ph.D. program will be given a qualifying examination shortly after the first term of graduate study.

### Faculty and Specializations

Biological applications of probability and statistics: F. B. Cady, R. R. Davidson, W. T. Federer, D. S. Robson, S. R. Searle, D. Solomon

Engineering and operations research applications of probability and statistics: R. E. Bechhofer, M. Brown, N. U. Prabhu, H. M. Taylor 3d, L. Weiss  
Mathematical theory of probability and statistics: L. D. Brown, R. Farrell, H. Kesten, J. Kiefer, F. L. Spitzer  
Social science applications of probability and statistics: I. Blumen, I. Francis, P. J. McCarthy  
Analysis and probability theory: M. Brown, H. Kesten, N. U. Prabhu, F. L. Spitzer, H. M. Taylor 3d, L. Weiss  
Design and analysis of experiments: R. E. Bechhofer, F. B. Cady, R. R. Davidson, W. T. Federer, J. Kiefer, D. S. Robson, S. R. Searle  
High-speed computing: I. Francis, S. R. Searle  
Statistical theory: R. Farrell, J. Kiefer, D. Solomon  
Ranking and selection procedures: R. E. Bechhofer  
Multivariate analysis: I. Blumen, L. Brown, I. Francis  
Nonparametric statistics: I. Blumen, L. Weiss  
Queueing and inventory theory: N. U. Prabhu  
Sampling theory: P. J. McCarthy, D. S. Robson  
Statistical control theory: H. M. Taylor 3d

## Urban Studies

### Field Representative

Barclay G. Jones, 111 W. Sibley Hall

### Minor Subject

Urban Studies

Urban Studies is an interdisciplinary minor field which provides students an opportunity to develop knowledge and understanding of urban society. It is intended to complement basic studies in such major fields as government, sociology, economics, history, city and regional planning, engineering, business and public administration, and human development. It should develop the student's competence in such subject areas as theories of urbanization, urban political processes, public policy and administration, urban ecology, urban economics, urban social structure, urban planning, and the processes of urban change. Because of the field's interdisciplinary character, students may not, for this minor, select a professor who also serves on the graduate faculty in the student's major field.

The student's dissertation research must show a close integration between his major field and the particular aspect of urban studies that has been selected. There will be opportunities for research support through the Center for Urban Development Research and through other University facilities.

### Faculty and Specializations

H. E. Aldrich: organizational behavior  
L. C. Carter, Jr.: public policy  
P. S. K. Chi: sociology  
P. Clavel: city and regional planning  
S. Clemhout: consumer economics  
A. T. Dotson: government  
P. R. Eberts: rural sociology  
E. S. Flash, Jr.: public administration  
W. W. Goldsmith: city and regional planning  
G. Hershey: city and regional planning  
B. G. Jones: city and regional planning  
P. W. Martin: law  
L. Reissman: sociology  
J. W. Reys: city and regional planning  
S. Saltzman: city and regional planning  
R. E. Schuler: economics  
S. W. Stein: urban planning and design  
J. E. Turner: Africana studies  
D. Van Houweling: government  
H. Y. Wan: economics



## Biological Sciences

**Agronomy, Animal Breeding, Animal Science, Biochemistry, Biology, Botany, Communication Arts, Conservation, Ecology and Evolutionary Biology, Entomology, Environmental Quality, Floriculture and Ornamental Horticulture, Food Science and Technology, Genetics, Human Nutrition and Food, International Agricultural Development, Medical Sciences (Graduate School of Medical Sciences), Microbiology, Neurobiology and Behavior, Nutrition, Physiology, Plant Breeding and Biometry, Plant Pathology, Pomology, Psychology, Statistics, Vegetable Crops, Veterinary Medicine, Zoology**

### Agronomy

#### Field Representative

Earl L. Stone, Jr., 907 Bradfield Hall

#### Major and Minor Subjects

Field Crop Science, Meteorology, Seed Technology (major only for M.S.), Soil Science

English-speaking applicants, where possible, should submit the results of the Graduate Record Examinations.

Ordinarily, students first complete a master's program, but direct admission to a doctoral program is permitted for exceptionally well-prepared students.

Since 1968, the Field has occupied one of the most modern and diversified agronomic research facilities in the world. An air-conditioned, eleven-story research tower and adjoining wings incorporate fully equipped laboratory, teaching, office, and supporting spaces. Graduate students have access also to newly constructed growth chambers and greenhouse facilities on the campus and to three main field stations near Ithaca. Seed technology studies are conducted also in new quarters at Geneva; students may arrange to work there while enrolled at Ithaca. Some members of the Field are staff members at the U. S. Plant, Soil, and Nutrition Laboratory (USDA) on the campus. A limited number of students can do most or all of their research overseas.

#### Faculty and Specializations

##### *Field Crop Science*

Crop chemistry: W. B. Duke, H. A. MacDonald, R. L. Obendorf

Crop ecology: G. W. Fick, R. B. Musgrave

Crop physiology: W. B. Duke, G. W. Fick, H. A. MacDonald, R. B. Musgrave, R. L. Obendorf, M. J. Wright

Crop preservation: R. B. Musgrave, M. J. Wright

Crop production: R. F. Lucey, R. R. Seanev

Seed Technology: B. E. Clark,\* A. A. Kahn,\*

H. A. MacDonald, L. W. Nittler\*

Weeds and herbicides: W. B. Duke, D. L. Linscott

##### *Meteorology*

General meteorology: B. E. Dethier, W. W. Knapp

Climatology and microclimatology: B. E. Dethier

Agricultural micrometeorology: E. R. Lemon

Physical meteorology: W. W. Knapp

##### *Soil Science*

Soil chemistry: J. M. Duxbury, D. L. Grunes, M. Peech

Soil fertility: W. H. Allaway, D. R. Bouldin, D. J. Lathwell, W. S. Reid, T. W. Scott, M. T. Vittum\*

Soil microbiology: M. Alexander

Soil morphology, genesis, and cartography: R. W. Arnold, M. G. Cline, J. Kubota, G. W. Olson

Soil mineralogy: R. M. Weaver

Soil physics: E. R. Lemon, R. D. Miller

Soil and water conservation: F. N. Swader, P. J. Zwerman

Soil and water studies in aquatic environments:

D. R. Bouldin, D. J. Lathwell, J. H. Peverly

Soils of the tropics: M. G. Cline, M. Drosdoff, R. H. Fox, and others

Forest soils: E. L. Stone, Jr.

Organic soils: J. M. Duxbury

##### *Other Faculty*

N. C. Brady, R. H. Fox (in Puerto Rico), W. K. Kennedy

\* Faculty of the New York Agricultural Experiment Station in Geneva.

## Animal Breeding

#### Field Representative

C. R. Henderson, B-22 Morrison Hall

#### Major and Minor Subjects

Animal Breeding, Animal Genetics

Entering students are expected to have had good basic undergraduate training in biology, chemistry, and mathematics. Previous experience with large animals or with poultry is desirable but not absolutely essential.

Graduate students are required to do some teaching during their course of study.

Superior facilities are available for graduate student training in each of the areas listed below. Students are expected to participate actively in these research programs and generally are provided assistantships.

#### Faculty and Specializations

Statistical genetics, with particular emphasis on selection programs for improvement of large animals:

R. W. Everett, C. R. Henderson, L. D. Van Vleck

Reproductive physiology and related areas, and use of various techniques in genetic improvement of populations: R. W. Bratton, R. H. Foote

Livestock breeding in the tropics: R. E. McDowell

Avian cytogenetics: S. E. Bloom

Poultry genetics: R. K. Cole

## Animal Science

#### Field Representative

S. E. Smith, 262 Morrison Hall

#### Major and Minor Subjects

Animal Breeding, Animal Nutrition, Animal Science, Dairy Husbandry, Meat Science, Physiology of Reproduction, Poultry Science (for M.S. only)

Applicants should have had a good selection of animal science courses and as many physical science and biology courses as possible.

A major in poultry science is available only at the Master's level, and a student who wishes training beyond that level should consider selecting a major in the Field of Animal Breeding, Food Science and Technology, Nutrition, or Physiology.

Ph.D. candidates are required to assist in teaching for at least two terms. Available to students in the Field is the F. B. Morrison Fellowship in Livestock Feeding which provides \$2,000 plus tuition.

#### Faculty and Specializations

##### *Animal Science*

Animal breeding: R. W. Bratton, R. W. Everett, R. H. Foote, C. R. Henderson, L. D. Van Vleck

Animal nutrition: J. M. Elliot, H. F. Hintz, D. E. Hogue,  
J. K. Loosli, W. G. Merrill, W. G. Pond, J. T. Reid,  
S. E. Smith, P. J. Van Soest, W. J. Visek, R. G. Warner  
Animal physiology: R. W. Bratton, R. H. Foote, W. Hansel,  
R. E. McDowell, G. H. Schmidt, H. F. Travis, W. J. Visek  
Beef husbandry: J. I. Miller  
Dairy husbandry: H. R. Ainslie, C. E. Coppock, J. M. Elliot,  
W. G. Merrill, R. P. Natzke, G. H. Schmidt, S. T. Slack,  
N. E. Smith, G. W. Trimberger, K. L. Turk  
Meats: J. R. Stouffer, G. H. Wellington  
Sheep husbandry: W. F. Brannon, D. E. Hogue  
Swine husbandry: E. A. Pierce, W. G. Pond

#### *Poultry Science*

Animal breeding: R. K. Cole  
Food Science: R. C. Baker  
Nutrition: M. C. Nesheim, M. L. Scott, R. J. Young  
Physiology: A. Bensadoun, A. van Tienhoven

## Biochemistry

### Field Representative

Stuart Edelstein, G-30 Wing Hall

### Major and Minor Subject

#### Biochemistry

Prior training should include calculus, physics, and chemistry sequences through introductory physical chemistry. The Graduate Record Examinations Aptitude Test and Advanced Test in Chemistry or Biology are required.

Ph.D. candidates are required to teach for two semesters.

### Faculty and Specializations

W. J. Arion: role of phospholipids in membrane function and structure, regulation of liver microsomal enzymes  
J. M. Calvo: control of metabolic pathways in bacteria, bacterial genetics  
L. J. Daniel: biochemical functions of vitamins B<sub>12</sub> and folic acid, interrelationship of vitamins and trace elements  
S. J. Edelstein: structure and function of proteins, analytical ultracentrifugation  
J. Fessenden-Raden: enzymes in oxidative phosphorylation, immunological approaches to oxidative phosphorylation and membrane structure  
G. R. Fink: regulation of histidine biosynthesis in yeast  
J. L. Gaylor: biosynthesis of sterols and steroid hormones, control mechanisms of sterol biosynthesis  
Q. H. Gibson: haemoproteins, flavoproteins, rapid reaction spectrophotometry, and physical methods in enzyme kinetics  
G. G. Hammes: biophysical chemistry, especially enzyme kinetics and mechanisms  
L. A. Heppel: structure and metabolism of nucleic acids, cell permeability in microorganisms  
G. P. Hess: protein-mediated reactions, biological specificity and control mechanisms  
P. C. Hinkle: mitochondrial ion transport and oxidative phosphorylation  
A. T. Jagendorf: electron transport and phosphorylation mechanisms in chloroplasts, synthesis of chloroplast proteins and their physiological controls  
E. B. Keller: enzymes, cofactors, and ribosomes in protein biosynthesis  
J. T. Madison: nucleotide sequence analysis of tRNA, studies on tRNA nucleotidyl transferase  
R. E. McCarty: photosynthetic phosphorylation and electron transport  
D. B. McCormick: enzymes concerned with transformation of vitamins and coenzymes

J. K. Moffat: x-ray determination of protein structure, the relationship between structure and function in hemoglobin  
A. L. Neal: metabolism of plant pathogenic organisms and malignant cells  
W. L. Nelson: biochemical mechanisms associated with functional states of cells  
E. Racker: mechanisms of enzyme action, control mechanism, structure and function in mitochondria and chloroplasts, mechanisms in bioenergetics  
G. Schatz: yeast mitochondria synthesis  
H. A. Scheraga: physical chemistry of proteins  
J. F. Thompson: nitrogen and sulfur metabolism of plants  
D. C. Wharton: cytochrome oxidase, metalloenzymes, electron transport  
H. H. Williams: biochemistry of proteins and amino acids, selenium metabolism in microorganisms  
D. B. Wilson: biochemical genetics, physical chemistry of enzymes  
J. F. Wootton: enzyme chemistry, relationships between structure and function  
L. D. Wright: biosynthesis of biologically active compounds, mevalonic acid metabolism, biotin metabolism  
R. Wu: nucleotide sequence analysis of phage DNA, control of enzyme and DNA synthesis in mammalian cells  
D. B. Zilversmit: mechanism of fat absorption, lipid transport, cell membranes

Combined graduate programs may be arranged with the following members of the staff of the New York Experiment Station in Geneva: L. M. Massey, Jr., L. R. Mattick, R. S. Shallenberger, J. P. VanBuren.

## Biology

### Field Representative

Lowell D. Uhler, 204 Stimson Hall

Applicants must submit scores on the Aptitude and Advanced Biology Test of the Graduate Record Examinations.

For those students who are teaching or intend to become teachers, and who are in need of additional subject matter in the biological sciences, a graduate program leading to the professional degree Master of Science for Teachers (M.S.T.) is available. The degree requires a minimum of thirty credit hours in residence of which at least twenty-two hours of course work must be in biology. A candidate must complete, or have completed: a course in organic chemistry, including laboratory work; a first-year introductory course in earth sciences; and a first-year introductory course in calculus and/or statistics and/or physics. The first-year introductory course in chemistry may not be counted toward the required thirty hours. If the student has not completed the above requirements in the physical and earth sciences, they will be added to his requirements for the degree.

## Botany

### Field Representative

Lloyd E. Powell, Jr., 121 Plant Science Building

### Major and Minor Subjects

Biosystematics, Cytology, Evolutionary Botany, General Botany (for M.S. only), Paleobotany, Phycology, Plant Ecology, Plant Morphology and Anatomy, Plant Physiology, Plant Taxonomy

It is strongly recommended that applicants provide scores of the Graduate Record Examinations. Students wishing to major in plant physiology are advised to obtain a

background in calculus, inorganic and organic chemistry, and physics before entry.

All candidates will normally take an oral prescriptive examination during the first semester of residence.

### Research Facilities

The Field offers exceptional facilities for all research programs related to the special interests of its faculty. Modern instrumentation, ranging from spectrophotometers to electron microscopes, is routinely available, as are growth and culture chambers and greenhouse facilities. The library ranks among the top ten in the country in number of botanical volumes, and the herbaria collectively represent one of the nation's major systematics resources. In the vicinity of the campus, Cornell owns many areas available for student research. Most of them are undeveloped and representative of a variety of habitats; however, some, such as the experimental ponds, are developed for specific research needs.

Students majoring in plant physiology will be able to obtain training leading to professional competence in the physiology, biochemistry, biophysics, or cellular biology of plants. Research may be directed toward fundamental science or toward the frontier between theory and agricultural or oceanographic applications.

### Requirements for Majors in Plant Physiology

In addition to advanced courses in the three main areas of plant physiology (water and ion movements, plant biochemistry, and plant development), degree requirements include a minimum of one intermediate or higher-level course in three other relevant biological subjects (i.e., genetics, cytology, plant morphology, animal physiology, cell biology, ecology, microbiology, plant pathology, etc.) and one course in each of two supporting fundamental sciences (usually biochemistry and either organic or physical chemistry, biophysics, or relevant parts of mathematics, including computer usage). These requirements may coincide in part with those of the minor subjects or may be satisfied by courses taken before entry. In addition to one major and two minor professors, each Ph.D. candidate will have a fourth voting member appointed by the plant physiologists to his Special Committee.

### Faculty and Specializations

- H. P. Banks: paleobotany, especially of the Devonian; anatomy and morphology
- D. F. Bateman: physiology, plant diseases caused by fungi and bacteria, cell-wall metabolism
- D. M. Bates: biosystematics and evolution of flowering plants
- R. T. Clausen: taxonomy, biosystematics, evolution and ecology of vascular plants
- R. K. Clayton: physical and photochemical mechanisms in photosynthesis
- L. L. Creasy: physiology and biochemistry of plant phenolics
- P. J. Davies: mode of action and transport of plant hormones; regulation of development, flowering and senescence in higher plants
- W. J. Dress: systematics and nomenclature of flowering plants, especially in the Compositae
- E. E. Ewing: nucleic acid metabolism; enzymes of potato tubers
- J. W. Ingram, Jr.: systematics of flowering plants with emphasis on anatomical approaches
- A. J. Jagendorf: electron transport, phosphorylation, ion fluxes and gradients in chloroplasts; protein and RNA synthesis in plastid development
- J. M. Kingsbury: phycology, aquatic and marine ecology, phytotoxicology

- R. P. Korf: systematics and nomenclature of fungi, lichens, and mycetozoa
- P. L. Marks: plant ecology
- H. E. Moore, Jr.: systematics of flowering plants, especially the Palmae, Gesneriaceae, and the Monocotyledonae in general
- R. L. Obendorf: physiology and biochemistry of cold sensitivity during germination and seedling development, greening and photosynthetic development
- J. L. Ozbun: photosynthesis, photorespiration, and nutrition of crop plants
- D. J. Paolillo, Jr.: developmental plant morphology and anatomy
- M. V. Parthasarathy: plant morphology and anatomy
- L. E. Powell, Jr.: plant hormones, dormancy, hormonal aspects of fruit development, analytical techniques for hormones
- R. M. Spanswick: ion transport in the Characeae and higher plants, electrophysiology of plant cell membranes
- P. L. Steponkus: stress physiology, biochemical mechanisms of cold acclimation, freezing injury, hormonal controls in high-temperature injury and senescence
- J. F. Thompson: reactions and control mechanisms in amino acid biosynthesis; protein synthesis
- H. B. Tukey, Jr.: physiology and growth regulation of higher plants; nutrition, uptake, and loss of substances by plants
- C. H. Uhl: chromosomes and cytotoxicology
- R. H. Whittaker: plant communities

### Communication Arts

(Please see p. 39.)

### Conservation

#### Field Representative

Milo E. Richmond, Fernow Hall

#### Major and Minor Subjects

Aquatic Science, Fishery Science, Wildlife Science, Natural Resources Conservation, Forest Conservation (minor subject only)

Applicants should be well prepared in biological sciences; a strong background in the physical sciences and a working knowledge of statistical methods are highly desirable. To major in natural resources conservation, the student should have previous training in some scientific discipline which he proposes to use in an integrative way to focus on natural resource problems, and he preferably should have professional job experience.

An oral qualifying examination is given to the Ph.D. candidates early in residence.

### Faculty and Specializations

Aquatic and fishery science: A. W. Eipper, W. H. Everhart, J. L. Forney, R. T. Oglesby, D. A. Webster  
 Forest conservation: A. Dickson, L. S. Hamilton, R. R. Morrow  
 Natural resources conservation: H. B. Brumsted, A. Dickson, W. H. Everhart, L. S. Hamilton, J. W. Kelley, R. J. McNeil, B. T. Wilkins  
 Outdoor recreation: H. B. Brumsted, B. T. Wilkins  
 Wildlife science: H. B. Brumsted, J. W. Kelley, R. J. McNeil, A. N. Moen, M. E. Richmond, J. Tate, D. Q. Thompson

### Ecology and Evolutionary Biology

#### Field Representative

William N. McFarland, 237 Langmuir Laboratory

### Major and Minor Subjects

Aquatic Ecology (including limnology, marine ecology, and oceanography), Community and Ecosystem Ecology, Environmental Physiology, Evolutionary Biology, General Ecology, Paleocology, Parasitology, Population Ecology, Terrestrial Ecology, Vertebrate Zoology (including herpetology, ichthyology, mammalogy, and ornithology)

Applicants are required to present scores on the Graduate Record Examinations Aptitude and Advanced Biology Tests. Three letters of recommendation are desired.

The language requirement for the Ph.D. degree is proficiency in two languages or superior ability in one. One language is required for the Master's degree. A written Field examination in the subject matter of ecology and evolutionary biology is normally taken during the student's second semester. In any event, it must be taken before the student can schedule an admission to candidacy examination. A final thesis examination is also required by the Graduate School.

Students obtain teaching experience as teaching assistants for two terms in one of several basic or advanced courses. This requirement may be waived for students who come to Cornell with teaching experience.

### Faculty and Specializations

Members of the faculty will be especially interested in directing research in the areas mentioned below, although research will not be limited to these areas. Prospective students will find it to their advantage to correspond before they apply with staff members whose interests are most closely related to their own.

- K. Adler: photoreception, orientation, navigation and circadian rhythms of vertebrates
- M. Alexander: microbial ecology
- H. W. Ambrose: behavioral ecology, social and orientation behavior of mammals
- J. P. Barlow: biological oceanography, plankton ecology
- W. L. Brown: systematics of ants, evolutionary theory
- P. F. Brussard: structure and genetics of natural populations, species diversity
- T. J. Cade: environmental biology of vertebrates
- R. T. Clausen: variation, evolution, distribution, and classification of flowering plants
- L. C. Cole: population ecology
- W. C. Dilger: vertebrate ethology
- G. C. Eickwort: systematics, behavior and evolution of wild bees and mites, pollination ecology
- T. Eisner: behavior of insects, chemical basis of behavior, biocommunication
- S. T. Emlen: behavioral ecology, evolution of behavior
- H. E. Evans: developmental and gross anatomy, teratology (fish to mammal)
- P. P. Feeny: chemical ecology of insect-plant relationships
- G. G. Gyrisco: population dynamics, insect flight, diapause, pesticide residues, insect sound
- R. G. Helgesen: quantitative population ecology of insects
- W. M. Howell: systematics of fishes
- H. C. Howland: mathematical biology, systems analysis
- J. W. Hudson: physiological ecology of mammals
- W. T. Keeton: ecology, evolution, and behavior of birds and noninsect arthropods
- J. M. Kingsbury: phycology
- J. P. Kramer: ecology and biology of entomopathogenic microbes, especially protozoans
- D. A. Lancaster: behavior of neotropical birds
- S. A. Levin: population biology, mathematical biology, applied mathematics
- G. E. Likens: limnology, aquatic ecology, analysis of ecosystems
- W. N. McFarland: comparative and environmental physiology of vertebrates

- P. L. Marks: plant ecology
- L. N. Miller: physiological plant ecology, plant water relations
- A. N. Moen: wildlife ecology, environmental stress on physiology and ecology of mammals and birds
- R. T. Oglesby: ecosystems, with particular emphasis on enrichment and population problems
- L. L. Pechuman: taxonomy, evolution, distribution and ecology of Diptera, especially Tabanidae and related families
- D. Pimentel: population ecology, ecosystems
- F. H. Pough: environmental physiology, especially of lower vertebrates, herpetology
- M. E. Richmond: vertebrate ecology and reproduction
- R. B. Root: comparative ecology and the organization of terrestrial communities
- E. L. Stone: forest soils, nutrition and nutrient cycles in natural vegetation
- M. J. Tauber: reproductive behavior, photoperiodism and biological control
- D. Q. Thompson: wildlife ecology
- L. D. Uhler: insect ecology
- D. A. Webster: population dynamics of fishes
- J. W. Wells: systematics and ecology of recent and fossil corals
- J. H. Whitlock: experimental epidemiology and endemiology
- R. H. Whittaker: plant communities

## Entomology

### Field Representative

Roger G. Young, 192 Insectary

### Major and Minor Subjects

Apiculture, Aquatic Entomology, Biological Control, Entomology (minor only), Economic Entomology, Insect Biochemistry, Insect Ecology, Insect Morphology, Insect Pathology, Insect Physiology, Insect Taxonomy, Insect Toxicology and Insecticide Chemistry, Medical Entomology, Parasitology

Excellent facilities for laboratory and field studies are available which include the outstanding Comstock Entomological Library and a foremost insect collection. Details on these facilities are available from the Field representative.

The Field of Entomology requires a prescriptive academic review for doctoral candidates, usually held during the first semester of work. The minimum requirement for the Ph.D. degree is one foreign language.

In addition to teaching and research assistantships and the Comstock Scholarship, traineeships are available in several areas.

### Faculty and Specializations

#### Ecology

- Behavior: J. M. Camhi, G. C. Eickwort, T. Eisner, R. A. Morse, W. L. Roelofs,\* M. J. Tauber
- Ecology: C. O. Berg, P. P. Feeny, G. G. Gyrisco, R. G. Helgesen, C. E. Palm, D. Pimentel, R. B. Root, M. J. Tauber, L. D. Uhler

#### Economic Entomology

- Apiculture: R. A. Morse
- Application equipment: J. L. Brann
- Chemistry of plant resistance to insects: P. P. Feeny
- Floricultural insects: R. G. Helgesen
- Forage insects: G. G. Gyrisco
- Fruit insects: E. H. Glass,\* S. E. Lienk,\* G. A. Schaefer,\* E. H. Smith, E. F. Taschenberg,\* K. Trammel\*



Household insects and insects affecting man:

E. M. Raffensperger

Insects of ornamentals: W. T. Johnson, J. L. Saunders,  
H. Tashiro\*

Livestock insects: J. G. Matthyse

Medical entomology: B. V. Travis

Vegetable insects: A. C. Davis,\* C. J. Eckenrode,\*  
A. A. Muka, M. Semel

#### *Aquatic Entomology*

C. O. Berg, L. L. Pechuman, B. V. Travis, R. T. Oglesby,  
D. A. Webster

#### *Morphology*

G. C. Eickwort, T. Eisner

#### *Parasitology*

General parasitology: J. P. Kramer, B. V. Travis

Insect pathology: J. P. Kramer

#### *Physiology and Biochemistry*

Biochemistry: J. M. Camhi, R. L. Patton, C. F. Wilkinson,  
R. G. Young

Physiology: J. M. Camhi, R. L. Patton, E. H. Smith,  
C. F. Wilkinson, R. G. Young

#### *Systematics*

Acarology: G. C. Eickwort, J. G. Matthyse, B. V. Travis

General systematics: W. L. Brown, Jr., G. C. Eickwort,

J. G. Franclemont, W. T. Keeton, L. L. Pechuman

Systematics of ants: W. L. Brown, Jr.

Systematics of bees: G. C. Eickwort

Systematics of Diptera: C. O. Berg, L. L. Pechuman

Systematics of Lepidoptera: J. G. Franclemont

Systematics of millipedes: W. T. Keeton

#### *Toxicology*

Analytical technology: D. J. Lisk

Bioassay: J. E. Dewey

Biochemical aspects: R. J. Kuhr,\* C. F. Wilkinson,  
R. G. Young

General toxicology: R. J. Kuhr,\* D. J. Lisk, C. F. Wilkinson,  
R. G. Young

Selective toxicants: R. D. O'Brien

Synergists: C. F. Wilkinson

\* Faculty of New York State Agricultural Experiment Station  
in Geneva.

## Floriculture and Ornamental Horticulture

### Field Representative

Peter L. Steponkus, 49B Plant Science Building

### Major Subject

Floriculture and Ornamental Horticulture

### Minor Subjects

Floriculture and Ornamental Horticulture, Landscape  
Architecture

Admission to the Field is based on the quality and nature of the applicant's prior training as well as on letters of recommendation. The applicant need not have done undergraduate work in horticulture, but he must have a good background in biological and agricultural sciences and an interest in ornamental plants.

For the M.S. degree, the Field requires a thesis to be based on the results of a research project and a final examination.

For the Ph.D. degree, the Field requires a qualifying examination taken early in the program, preferably no later than the second term of residence, in addition to the other examinations required by the Graduate School.

There is no specific foreign language requirement by the Field for the M.S. and Ph.D. degrees; however, the Special Committee may recommend or require proficiency in a foreign language for the Ph.D.

### Research Opportunities

Excellent opportunities for graduate study and research are offered in all phases of floriculture and ornamental horticulture. Areas of specialization include greenhouse floriculture crops, nursery crops, turfgrasses, ornamental horticulture physiology, taxonomy of ornamental plants, and landscape architecture. Studies relating to the physiology, growth and development, propagation, nutrition and culture of floriculture and nursery crops and turfgrasses may be undertaken as research for an advanced degree and should be approached from the standpoint of the basic sciences. Consequently, it is appropriate to select minor areas of study from such areas as plant physiology, pathology, biochemistry, botany, entomology, anatomy, morphology, taxonomy, plant ecology, genetics, agricultural economics, and agricultural engineering.

Outstanding facilities include laboratories specifically equipped for studies on growth regulators, foliar and soil analysis, radioisotopes, tissue culture, stress physiology, postharvest physiology, and various other physiological and anatomical topics. New controlled environment rooms, greenhouses and outdoor nursery, and turfgrass production areas are also available.

### Faculty and Specializations

M. I. Adleman: landscape architecture (at M.S. level only), especially site analysis and development, planting design, recreation, and land planning

J. W. Boodley: culture of greenhouse flower crops, especially foliar analysis, soils and nutrition

J. F. Cornman: turfgrass production and maintenance, weed control

R. T. Fox: retail florist shop management (at M.S. level only), merchandizing, layout and shop efficiency

G. L. Good: culture of nursery crops, especially nutrition and container production

R. W. Langhans: culture of greenhouse flower crops, especially greenhouse environments and propagation by tissue culture

R. G. Mower: taxonomy of ornamental plants, plant evaluation and selection for landscape characteristics

R. J. Scannell: landscape architecture (at M.S. level only), especially parks planning and development

J. G. Seeley: culture of greenhouse flower crops, especially nutrition

P. L. Steponkus: physiology of horticultural crops, especially cold acclimation and freezing injury, high-temperature injury and senescence, and postharvest physiology of cut flowers

H. B. Tukey, Jr.: physiology of horticultural crops, especially uptake and loss of substances by plants, chemical ecology, propagation and growth regulation

## Food Science and Technology

### Field Representative

Robert C. Baker, 100 Rice Hall

### Major and Minor Subjects

Dairy Science, Food Chemistry, Food Microbiology, Food Science (general), International Food Development, Water and Waste Water Microbiology

Applicants should have good training in biology, chemistry, microbiology, and biochemistry; prior training in food science is desirable. Applicants must submit scores of the Graduate Record Examinations Aptitude Test.

In addition to the examinations required by the Graduate School, a qualifying examination is required of Ph.D. candidates early in residence; this may be combined with the final examination for the master's degree.

### Research Opportunities

The Field offers excellent opportunities for graduate study. All course work is taken on the Ithaca campus, but students may conduct their research at the New York State Agricultural Experiment Station in Geneva, where a new pilot plant and laboratories are available. A smaller pilot plant located on the Ithaca campus supplements the very adequate departmental research facilities.

### Faculty and Specializations

*Dairy Science:* R. F. Holland, L. F. Hood, W. K. Jordan, J. E. Kinsella, F. V. Kosikowski, R. A. Ledford, R. P. March, H. B. Naylor, N. N. Potter, J. W. Sherbon, W. F. Shipe, J. C. White, R. R. Zall

*Food Chemistry:* T. Acree,\* G. D. Armbruster, M. C. Bourne,\* P. A. Buck, L. R. Hackler,\* E. E. Hester, L. F. Hood, G. Hrazdina,\* J. E. Kinsella, C. Y. Lee,\* B. A. Lewis, L. M. Massey, Jr.,\* L. R. Mattick,\* N. Mondy, W. B. Robinson,\* R. S. Shallenberger,\* J. W. Sherbon, W. F. Shipe, L. L. Smith, G. S. Stoewsand,\* D. V. Vadehra, J. P. VanBuren,\* R. H. Walter,\* G. H. Wellington

*Food Microbiology:* P. A. Buck, N. C. Dondero, R. K. Finn, D. C. Graham, F. V. Kosikowski, R. A. Ledford, H. B. Naylor, N. N. Potter, D. F. Splittstoesser,\* J. R. Stamer,\* K. H. Steinkraus,\* D. V. Vadehra, J. C. White

*Food Science (General):* T. Acree,\* G. D. Armbruster, R. C. Baker, M. C. Bourne,\* P. A. Buck, D. L. Downing,\* R. K. Finn, D. C. Graham, L. R. Hackler,\* R. F. Holland, L. F. Hood, F. M. Isenberg, W. K. Jordan, J. E. Kinsella, F. V. Kosikowski, R. L. LaBelle,\* C. Y. Lee,\* L. M. Massey, Jr.,\* N. Mondy, J. C. Moyer,\* H. B. Naylor, E. A. Pierce, N. N. Potter, W. B. Robinson,\* J. W. Sherbon, W. F. Shipe, L. L. Smith, D. F. Splittstoesser,\* K. H. Steinkraus,\* G. S. Stoewsand,\* J. R. Stouffer, D. V. Vadehra, J. P. VanBuren,\* G. H. Wellington, J. C. White, R. R. Zall

*International Food Development:* M. C. Bourne,\* P. A. Buck, L. R. Hackler,\* L. F. Hood, W. K. Jordan, J. E. Kinsella, F. V. Kosikowski, R. L. LaBelle,\* C. Y. Lee,\* W. F. Shipe, K. H. Steinkraus,\* D. V. Vadehra, G. H. Wellington

*Water and Waste Water Microbiology:* N. C. Dondero, R. K. Finn, D. F. Splittstoesser,\* J. C. White, R. R. Zall

\* Faculty of the New York State Agricultural Experiment Station in Geneva.

### Genetics

(See also the listing under Medical Sciences.)

### Field Representative

Adrian M. Srb, 219 Bradfield Hall

### Major and Minor Subject

Genetics

Applicants are urged to submit scores of the Graduate Record Examinations Aptitude and Advanced Biology Tests. Proficiency in at least one foreign language is required for the doctoral degree.

Shortly after its formation, the student's Special Committee meets with the student in order to examine his past training and research interests and to recommend a course of study.

All students in the Field will have some teaching experience during their course of study.

Faculty members in the Field of Genetics have widely different research interests ranging from molecular through cytological, physiological, developmental, and evolutionary genetics. The student should choose a professor whose interests coincide with his own.

### Faculty

A. Blackler, P. J. Bruns, J. M. Calvo, G. R. Fink, R. L. Hallberg, R. J. MacIntyre, A. M. Srb, H. T. Stinson, C. H. Uhl, B. Wallace, S. A. Zahler

### Human Nutrition and Food

#### Field Representative

Katherine Newman, 377 Martha Van Rensselaer Hall

#### Major and Minor Subjects

Human Nutrition, Human Nutrition and Food, Food, Administrative Dietetics (major only for M.S.)

Training in basic food science and human nutrition, general and organic chemistry, biochemistry, microbiology, and physiology is required. Any deficiencies must be made up after admission.

All applicants are asked to submit results of the Graduate Record Examinations.

### Research and Study Opportunities

Graduate study in the Field emphasizes the application of the physical, biological, behavioral, and social sciences to human nutrition, food science, and administrative dietetics. In nutrition, the student may choose either laboratory work or field experience applying the social sciences. In foods, he may apply principles and techniques of organic chemistry, biochemistry, biological science, and microbiology to food problems. In administrative dietetics, he may apply the basic sciences to problems in administrative or management aspects of dietetics.

### Faculty and Specializations

#### Human Nutrition

J. Bowering: iron requirements, applied clinical nutrition  
M. Devine: ascorbic acid metabolism, nutrition education  
M. C. Latham: international nutrition  
M. A. Morrison: utilization of proteins and amino acids, nutrition field studies  
K. J. Newman: nutrition and growth, and social nutrition  
J. M. Rivers: ascorbic acid metabolism, nutrition and disease, community nutrition  
D. Roe: sulfur metabolism in humans  
D. Sanjur: food habits and social correlates  
R. Schwartz: magnesium requirements in reproduction  
C. M. Young: body composition studies, obesity, frequency of feeding studies

#### Food Science

G. Armbruster: interrelationships in plant tissue properties and product quality  
E. E. Hester: cereal chemistry  
B. Lewis: food carbohydrates, polysaccharide-protein interactions  
N. Mondy: enzyme and lipid chemistry in plants

#### Administrative Dietetics

K. O. Visnyei: food service in health care facilities

### International Agricultural Development

(Please see p. 47.)

## Medical Sciences (Graduate School of Medical Sciences)

Requests for information regarding the Fields in the Medical Sciences should be addressed to Professor Julian R. Rachele, Associate Dean, Graduate School of Medical Sciences, Cornell University Medical College, 1300 York Avenue, New York, N. Y. 10021. (See also p. 17 of this *Announcement*.)

### Biochemistry

Research opportunities are offered in areas such as: enzymology; mechanism of enzyme action; intermediary metabolism; physical chemistry and structure of proteins, nucleic acids, and other macromolecules; neurochemistry; hormone chemistry and action; molecular biology; and synthesis and biochemical action of chemotherapeutic compounds. The Field also offers advanced courses and seminars on the chemistry and biochemistry of carbohydrates, lipids, nucleic acids, and proteins, and on the methodology of physical biochemistry.

### Biological Structure and Cell Biology

Graduate study in this Field emphasizes the basic relationships between structure and function of biological systems at all levels of organization. Thus the Field is fundamentally concerned with the nature, development, and functional modulation and with significance of configuration, pattern, and other spatial relations in biological systems. The scope of interest extends from the molecular level to that of the whole organism and embraces normal as well as pathological structure.

### Biology

The program in biology at the Sloan-Kettering Division of the Graduate School of Medical Sciences 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 cell biology, cytology, genetics, immunology, microbiology, pharmacology, and virology.

### Biomathematics

A flexible program of applied mathematics in biology is offered to students whose primary interests are mathematical or theoretical, but who wish to concentrate on biological applications.

### Biophysics

Graduate work toward both the Ph.D. degree in the Field of Biophysics and the M.S. degree in the Field of Radiation Physics is offered. Active research programs are being conducted in fundamental radiation biophysics, including cellular radiobiology, and in the biophysics of membrane transport.

### Genetics

Opportunities are available in several different areas including cytogenetics, human biochemical and cell genetics, mammalian developmental genetics, microbial genetics, nucleic acid chemistry and biochemistry, and virology.

### Microbiology

This widely diversified Field draws on faculty and facilities of the Medical School and the Sloan-Kettering Institute. Courses and thesis research are available in general and medical bacteriology, microbial chemistry and physiology, virology, immunology, genetics, and mycology.

## Neurobiology and Behavior

The Field offers an integrated multidisciplinary approach with emphasis on neurochemistry, neurophysiology, and neuropsychology and perception. Special facilities are available for research with humans and with experimental primates.

### Pathology

Through the study of the disciplines of anatomic and clinical pathology, and in learning modern techniques of biologic investigation, the graduate program in pathology provides the student with a basic knowledge of disease processes. The student completing this program will have both the information and the technical skills to make significant inquiries into the nature of disease processes and to bridge the gap between classical, descriptive pathology, and such disciplines as biochemistry and molecular biology.

### Pharmacology

Opportunities for thesis research include the influence of drugs and chemicals on biochemical systems; the peripheral, autonomic and voluntary nervous systems; the central nervous system, the cardiovascular system, the kidney; and the relationship between chemical structure and biological activity.

### Physiology

Facilities are available for studies of function in intact animals, whole organs, subunits of organs, isolated cells, and subcellular systems.

## Microbiology

(See also the section on p. 63.)

### Field Representative

H. W. Seeley, Jr., 310 Stocking Hall

### Major and Minor Subject

Microbiology (See also the Field of Veterinary Medicine.)

Applicants should have preparation in general chemistry at an intermediate level, organic chemistry, physics, and introductory courses in the biological sciences. In addition, training in physical chemistry and calculus is desirable. While deficiency in the subjects listed does not preclude admission, it may increase the time necessary to earn a degree.

Applicants are required to submit scores for the Graduate Record Examinations Aptitude Test.

One semester or more of teaching is required of all graduate students.

Well-equipped laboratories are available. Staff research interests include bacterial viruses, genetics, immunology, physiology, biochemistry, molecular biology, systematic and environmental microbiology, and microbial ecology.

### Faculty and Specializations

Bacterial photosynthesis and metabolic control: J. Gibson  
Bacterial viruses: H. B. Naylor

Food microbiology: H. B. Naylor, D. F. Splittstoesser,\*

J. R. Stamer,\* K. H. Steinkraus,\* D. V. Vadehra

Immunology: L. I. Slobin

Industrial fermentations and bioengineering: R. K. Finn,  
K. H. Steinkraus\*

Microbial ecology: M. Alexander, E. A. Delwiche,

R. E. MacDonald, H. W. Seeley, Jr.

Microbial genetics and metabolic control: S. A. Zahler

Microbial nutrition: H. W. Seeley, Jr., P. J. VanDemark

## 58 Nutrition

Microbial physiology: E. A. Delwiche, J. Gibson,  
H. W. Seeley, Jr., D. V. Vadehra, P. J. VanDemark  
Soil microbiology: M. Alexander  
Water and waste microbiology: N. C. Dondero  
Molecular biology: R. E. MacDonald, L. I. Slobin

\* Faculty at the New York State Agricultural Experiment  
Station in Geneva

## Neurobiology and Behavior

(See also the listing under Medical Science.)

### Field Representative

Thomas R. Podleski, 119 Langmuir Laboratory

### Major and Minor Subjects

Neurobiology (including neurophysiology, neurochemistry,  
sensory physiology, neuroanatomy, theory of brain  
functions), Behavioral Biology (including ethology)

Applicants must present scores of the Graduate Record  
Examinations Aptitude Test and one of the advanced  
sciences tests.

For the Ph.D. degree, either high proficiency in one foreign  
language (French, German, or Russian) or medium  
proficiency in two languages is required. Students may  
petition to substitute another language.

The Field requires each student to attend an orientation  
meeting with his Special Committee during the first  
semester of study and to acquire teaching experience  
while at Cornell.

### Faculty and Specializations

K. Adler: photoreception, orientation, navigation and  
circadian rhythms of vertebrates, particularly amphibians  
and reptiles; population dynamics of salamanders  
K. Arms: embryology of nerve and muscle; ontogeny of  
behavior  
J. Camhi: behavioral neurophysiology of invertebrates  
R. Capranica: animal communication; auditory  
neurophysiology  
J. F. Cummings: comparative neurology and histology  
A. de Lahunta: clinical neurology; neural pathology  
W. C. Dilger: comparative ethology of vertebrates;  
behavioral evolution and ontogeny  
G. C. Eickwort: arthropod behavior; evolution of social and  
nest-building behavior  
T. Eisner: chemical communication; insect behavior and  
physiology  
M. E. Eldefrawi: neuropharmacology; receptology  
S. T. Emlen: animal orientation systems; adaptive  
strategies of vertebrate social behavior  
E. L. Gasteiger, Jr.: electrical activity of the vertebrate  
nervous system; neural nets  
P. W. Gilbert: biology of the elasmobranch fishes;  
functional vertebrate anatomy  
R. M. Grossfeld: neurochemistry; synaptic transmission;  
axonal transport  
B. Halpern: sensory physiology; chemoreception  
H. C. Howland: sensory physiology; mathematical biology  
R. E. Johnston: vertebrate social behavior; olfaction and  
chemical communication in mammals  
W. T. Keeton: animal orientation and navigation; evolution  
of behavior  
M. Kim: neurophysiology; systems analysis  
E. Lenneberg: brain and behavior; perception and language  
acquisition in animals and man  
R. D. O'Brien: neuropharmacology; neurochemistry  
T. R. Podleski: neurochemistry; membrane physiology  
M. M. Salpeter: electron microscopy; E. M. autoradiography,  
neurotrophic phenomena on ultrastructural level

D. N. Tapper: sensory physiology; receptor and central  
integration processes  
A. van Tienhoven: neuroendocrinology

## Nutrition

### Field Representative

J. Thomas Reid, 149 Morrison Hall

### Major and Minor Subject

Nutrition

Preparation is highly desirable in analytical and organic  
chemistry, general biology or zoology, genetics,  
mathematics, physics, physiology, and a foreign language.  
If deficiencies in background preparation must be made  
up, a longer time will be necessary to complete the degree.

For the master's degree, the student must have one major  
and one minor subject; for the Ph.D. degree, two minor  
subjects. A qualifying examination is required in addition  
to the examinations required by the Graduate School.

The Field coordinates the programs in nutrition in the  
several separate colleges and units of the University.  
Strong programs in animal nutrition, nutritional  
biochemistry, and human and clinical nutrition, including  
international nutrition, are maintained.

A professional degree of Master of Nutritional Science is  
administered by the Graduate School of Nutrition;  
interested students should communicate with the Secretary  
of the Graduate School of Nutrition, Savage Hall.

### Research and Study Opportunities

According to their interests, candidates may acquire  
training in biochemistry, economics, food technology,  
histology, nutrition, organic and inorganic chemistry,  
pathology, physiology, and other areas of science and  
technology. Either biochemistry or physiology is usually  
recommended as a minor for the Master's degree, and both  
as minors for the doctorate.

A wide latitude is allowed in the selection of the thesis  
research problem. Studies can be of a fundamental nature  
or applied to animal or human nutrition, including  
international nutrition.

### Faculty and Specializations

Faculty interests include: proteins and amino acids, fats,  
energy metabolism, vitamins, minerals, digestion,  
absorption, nutrient transport, nutritional pathology,  
endocrine-nutrition interrelationships, and nutrition  
education. Each of these special subjects can be studied  
with a variety of animal species.

Clinical and human nutrition studies: R. H. Barnes,  
M. Devine, M. C. Latham, M. A. Morrison,  
K. J. Newman, J. M. Rivers, D. Roe, R. Schwartz,  
W. J. Visek, C. M. Young

Nonruminant nutrition studies with dogs, horses, laboratory  
animals, mink, poultry, swine: R. E. Austic, R. H. Barnes,  
A. Bensadoun, C. L. Comar, M. Devine, J. M. Elliot,  
J. L. Gaylor, L. R. Hackler, H. F. Hintz, D. E. Hogue,  
L. Krook, F. W. Lengemann, J. K. Loosli,  
D. B. McCormick, M. C. Nesheim, W. G. Pond,  
J. T. Reid, J. M. Rivers, M. L. Scott, B. E. Sheffy,  
S. E. Smith, H. F. Travis, D. R. Van Campen, W. J. Visek,  
R. G. Warner, R. H. Wasserman, L. D. Wright, R. J. Young

Ruminant nutrition studies with beef cattle, dairy cattle,  
sheep, goats: C. E. Coppock, J. M. Elliot, D. E. Hogue,  
L. Krook, F. W. Lengemann, J. K. Loosli, W. G. Merrill,  
J. T. Reid, S. E. Smith, P. J. Van Soest, R. G. Warner



## Physiology

(See also the listing under Medical Sciences.)

### Field Representative

G. H. Schmidt, 276 Morrison Hall

### Major and Minor Subjects

Cellular Physiology, Comparative Physiology, Physical Biology, Vertebrate Physiology

See also listing under special interests of the faculty for major area subjects. Minors may be selected from such areas as biochemistry, biometry, chemistry, ecology, electrical engineering, genetics, histology, microbiology, nutrition, pathology, physics, and psychology.

All applicants, where possible, should submit the results of the Graduate Record Examinations Aptitude and Advanced Biology Tests. Preparation should include a good knowledge of biology, chemistry, biochemistry, and physics. Calculus, statistics, and genetics are also advisable.

The Field requires that doctoral candidates pass a qualifying examination, taken before two residence units have been earned, and that each candidate teach at least one semester, unless the Special Committee deems it inadvisable or inappropriate.

A doctoral candidate in Physiology must have two minor subjects. At least one of the minor committeemen must not be a member of the Field of Physiology.

### Faculty and Specializations

*A prospective student is urged to correspond with the professor in the list below whose interests are nearest his own.*

Behavioral physiology: T. Eisner, P. W. Gilbert, and H. C. Howland

Biochemistry, membrane structure: W. J. Arion and G. Lust

Cardiovascular physiology: E. N. Bergman, A. Dobson, A. F. Sellers

Comparative neurology and neuropharmacology: M. M. Salpeter

Comparative physiology: W. N. McFarland, F. H. Pough

Electrophysiology: L. L. Nangeroni

Endocrinology: W. Hansel, A. van Tienhoven

Environmental physiology: J. W. Hudson

Enzymology: J. F. Wootton

Gastrointestinal physiology: A. Bensadoun, A. Dobson, T. R. Houpt, A. F. Sellers, C. E. Stevens, W. J. Visek, R. H. Wasserman

Herpetology: F. H. Pough

Histology, cytology, and electron microscopy:

M. M. Salpeter and W. A. Wimsatt

Insect physiology: T. Eisner, R. L. Patton

Lactation: G. H. Schmidt

Lipid transport and metabolism: A. Bensadoun and D. B. Zilversmit

Metabolism: E. N. Bergman, T. R. Houpt, F. W. Lengemann, W. J. Visek

Neurophysiology: E. L. Gasteiger, P. W. Gilbert, and D. N. Tapper

Pathological physiology: G. Lust, H. F. Schryver

Pharmacology and toxicology: A. L. Aronson

Psychology: B. Halpern

Radiation biology and physical biology: A. P. Casarett, C. L. Comar, F. W. Lengemann and R. H. Wasserman

Reproduction: R. W. Bratton, A. P. Casarett, R. H. Foote, P. W. Gilbert, W. Hansel, A. van Tienhoven, W. A. Wimsatt

Ruminant physiology: E. N. Bergman, A. Dobson, A. F. Sellers, C. E. Stevens

Vertebrate physiology: P. W. Gilbert, T. R. Houpt, L. L. Nangeroni, A. F. Sellers, W. A. Wimsatt

## Plant Breeding and Biometry

### Field Representative

Neal F. Jensen, 420 Bradfield Hall

### Major and Minor Subjects

Plant Breeding, Biometry, Plant Genetics

Plant breeding and plant genetics cannot be a major-minor combination; however, genetics (Field of Genetics) may be a minor.

Applicants should be well grounded in the fundamentals of the natural sciences and should have had courses in advanced chemistry, biology, calculus, and physics. Students intending to specialize in biological statistics will find it to their advantage to have additional training in mathematics.

All students must pass an English proficiency examination.

Students interested in crop improvement through breeding, the genetics of higher plants, population dynamics, or quantitative inheritance studies with higher plants may choose plant breeding or plant genetics as a major. Research may involve studies of breeding methods, application of genetic principles to breeding, and correlation of knowledge from other areas such as biochemistry and statistics in attacks on problems of yield, quality, adaptability, and disease-insect resistance. Plant genetics generally involves research more specifically aimed towards the analysis of hereditary and evolutionary phenomena.

Students with mathematical interests in the development and application of statistical models in biology may elect a biometry major. Research problems may be purely theoretical studies, computer simulation studies, novel statistical analyses of real data, or may involve a combination of these approaches to various topics, such as estimation and sampling, the design and analysis of experiments, statistical genetics, quantitative ecology, or epidemiology.

Students majoring in plant breeding or plant genetics will find it necessary to remain in Ithaca during the summer or to make arrangements elsewhere for growing and studying the material used in connection with their research problems. Special provisions are available for students who would like to do their thesis research in Latin America.

### Faculty and Specializations

Members of the staff are especially interested in directing research in the areas listed below, although research will not be limited to those areas. Staff listed under plant breeding direct thesis research on the genetics of the crop plants with which they are primarily concerned. Staff listed under biometry direct theses on various aspects of statistical and mathematical genetics.

#### Biometry

W. T. Federer: statistics and experimental design

D. S. Robson: statistics and biometrical genetics

S. R. Searle: statistics and computing

D. L. Solomon: statistics and biomathematics

T. D. Mount: economic statistics

F. B. Cady: response surface designs, estimation and statistical analyses

R. R. Davidson: theory of tournaments and paired comparisons and meteorological statistics

#### Plant Breeding

R. E. Anderson: golden nematode resistance in potatoes

C. C. Lowe, R. P. Murphy: forage crops

W. D. Pardee: extension and pure seed programs

C. O. Grogan: corn

N. F. Jensen: small grains

- H. M. Munger, D. H. Wallace: vegetable crops  
 R. L. Plaisted: potatoes  
 L. V. Crowder: international agriculture, tropical forage crops  
 V. E. Gracen: genetics and biochemistry of insect and disease resistance

At the New York State Agricultural Experiment Station in Geneva

- D. W. Barton, J. Einset, R. C. Lamb, G. A. Marx,  
 D. K. Ourecky, R. W. Robinson, R. D. Way

## Plant Pathology

### Field Representative

Roy L. Millar, 360 Plant Science Building

### Major and Minor Subjects

Plant Pathology, Mycology

A student majoring in one of these subjects is generally advised not to minor in the other.

Broad training in the biological and physical sciences is essential; course work or experience in plant pathology is not required. The applicant must present his scores on the Graduate Record Examinations Aptitude Test.

Every student majoring in plant pathology or mycology is expected to take an oral, or oral and written, qualifying examination within the first twelve months after registration, in addition to the examinations required by the Graduate School.

Excellent opportunities for study and research are offered in all phases of plant pathology and mycology. Summer field trips with staff members give students experience in diagnosing diseases and in observing up-to-date control practices. All students are expected to obtain teaching experience in plant pathology and to become familiar with extension techniques.

Students majoring in plant pathology may elect to specialize in a particular branch of plant pathology, e.g., bacteriology, epidemiology, nematology, physiology of disease, virology, and tropical plant pathology; or in a crop-oriented area, e.g., diseases of forage, fruit, ornamentals, potatoes, vegetables, shade trees and shrubs, small grains, corn, and turf grasses. Students electing a major in mycology may develop their research program in cytology, genetics, morphology, physiology, or taxonomy.

An outstanding mycological and plant pathological herbarium, superior library facilities, excellent controlled-environment facilities, and modern equipment are available.

Further information is given in the brochure *Graduate Study in Plant Pathology and Mycology at Cornell*, which may be obtained from the Field representative.

### Faculty and Specializations

- J. R. Aist: research, pathological histology, root diseases  
 H. S. Aldwinckle: research, genetics of resistance of fruit trees to fungi  
 P. A. Arneson: extension, fruit diseases  
 D. F. Bateman: teaching and research, disease and pathogen physiology  
 S. V. Beer: research, fruit diseases, disease physiology  
 C. W. Boothroyd: teaching, general plant pathology; research, corn diseases, soil-borne pathogens  
 A. J. Braun: research, small fruit diseases, nematology, virology, fungicides  
 S. W. Braverman: research, plant introductions, disease resistance  
 B. B. Brodie: research, nematology  
 R. C. Cetas (at Riverhead): research, vegetable and potato diseases, fungicides, breeding for resistance

- R. S. Dickey: teaching and research, phytopathogenic bacteria  
 W. E. Fry: teaching and research, plant disease control  
 R. M. Gilmer: research, deciduous fruit diseases, virology  
 J. D. Gilpatrick: research, fungus diseases, fungicides  
 G. E. Harman: research, fungal effects on seed germination  
 M. B. Harrison (at Farmingdale): research, diseases caused by nematodes, turf diseases, soil fumigation  
 R. K. Horst: extension and research, diseases of florist and ornamental plants  
 W. T. Johnson: extension, pests of trees and shrubs on home grounds, 4-H Club work  
 E. D. Jones: extension and research, diseases of potatoes, potato certification, foundation seed programs  
 G. C. Kent: teaching, advanced plant pathology  
 R. P. Korf: teaching, mycology; research, taxonomy, morphology, cytology, and ecology of fungi  
 J. W. Lorbeer: teaching, mycology; research, diseases of vegetables, soil-borne pathogens, fungal genetics, epidemiology  
 W. F. Mai: teaching, nematology; research, etiology and control of diseases caused by nematodes, nematode physiology and taxonomy  
 R. L. Millar: teaching, advanced plant pathology; research, physiology of infection, diseases of field and forage crops  
 F. J. Polach: research, inheritance of pathogenicity in bacteria and fungi  
 W. F. Rochow: research, virus diseases of cereal crops, aphid transmission of plant viruses  
 A. F. Ross: teaching, plant virology; research, induced resistance, viruses and virus diseases, interaction of plant viruses  
 O. E. Schultz: extension, diseases of potatoes, turf, grain, and forage crops  
 A. F. Sherf: extension, vegetable diseases  
 W. A. Sinclair: teaching, extension and research, diseases of trees and shrubs  
 M. Szkolnik: research, fruit diseases, fungicides, systemics  
 H. D. Thurston: teaching and research, potato diseases, breeding for disease resistance, tropical plant diseases and control  
 U. K. Ueymoto: research, virology  
 H. D. VanEtten: research, disease and pathogen physiology  
 R. E. Wilkinson: research, diseases of vegetable crops, virus diseases, disease control  
 C. E. Williamson (at Farmingdale): research and extension, diseases of florist crops, nematology, soil fumigation  
 O. C. Yoder: research, post-harvest diseases

\* Faculty at the New York State Agricultural Experiment Station in Geneva.

## Pomology

### Field Representative

Lloyd E. Powell, Jr., 121 Plant Science Building

### Major and Minor Subject

Pomology

An applicant to this Field need not have done his undergraduate work in horticulture, but he should have a good background in the basic sciences and an interest in fruit plants. A knowledge of botanical and chemical subjects is particularly helpful. During his graduate work the student is expected to become well acquainted with the Field of Pomology and with other Fields closely allied to his thesis problem. A student registered in a Ph.D. degree program must take a qualifying examination in addition to the examinations required by the Graduate School.

Cornell University has two Departments of Pomology; one on the main Ithaca campus and one on its Geneva campus, fifty miles away at the New York State Agricultural Experiment Station. Members of these Departments are currently engaged in a great variety of research projects concerning growth-regulating substances, post-harvest physiology, mineral nutrition, cold hardiness, rest period, root initiation, rootstocks, fruit set and development, fruit breeding, plant pigments, and general cultural practices. Students take their course work at Ithaca but may conduct thesis research at either Ithaca or Geneva.

### Faculty and Specializations

#### At Ithaca

- G. D. Blanpied: post-harvest physiology
- L. L. Creasy: physiology and biochemistry of plant phenolics
- L. J. Edgerton: growth regulators and fruit culture; abscission; cold hardiness
- D. C. Elfving: water relations; tree fruit production
- G. H. Oberly: mineral nutrition; soils; tree fruit production
- L. E. Powell, Jr.: plant hormones; dormancy; hormonal aspects of fruit development; analytical techniques for hormones
- R. M. Smock: post-harvest physiology; international pomology
- J. P. Tompkins: small fruits; grapes

#### At Geneva

- J. C. Cain: mineral nutrition; pruning and training methods; mechanization of pruning and harvesting
- J. N. Cummins: rootstock breeding, propagation and testing; high density systems; rooting studies
- O. F. Curtis, Jr.: weed control; juvenility; apple fruit growth
- J. Einset: cytogenetics; grape breeding
- C. G. Forshey: mineral nutrition; growth regulators; fruit tree physiology
- W. J. Kender: plant growth hormones; physiology of flowering and fruit crops; culture of small fruits
- R. C. Lamb: breeding for disease resistance in apples and pears, and for cold resistance in peaches and apricots
- D. K. Ourecky: small fruit breeding; cytogenetics; cytology
- N. J. Shaulis: general viticulture, with emphasis on leaf environment as affected by training, spacing, and vine size; mechanization
- R. D. Way: apple and cherry cultivar evaluation, breeding, and genetics

Special requirements of the Field are determined by a conference consisting of the graduate students and faculty in the Field. All students will have at least ten hours per week of supervised teaching experience for two semesters, and a one-year course in statistics and experimental design.

During the second semester in residence, each student will submit to his Special Committee a report detailing the academic work and research carried out during the year. The student will then arrange a first-year review committee meeting to discuss the report.

Each student will draw up a proposal for his studies, including a proposal for breadth in training. The proposal should be approved by the student's Special Committee by the end of the first term in residence, and copies should be supplied to the Committee and the Field representative. A fourth member of the Special Committee who is appointed by the Field representative has greater responsibility than the other Committee members for insuring that the student has adequate breadth.

At an appropriate time, each student will submit to his Special Committee a written thesis proposal.

For the examination for admission to candidacy and for the final examination, notification must be sent to all Field faculty two weeks in advance.

A prospective student is advised to consult the brochure *Supplementary Guide for Graduate Students in the Field of Psychology*, which may be obtained by writing to the Field representative.

Fellowships specifically for students in this Field are: the National Institutes of Health Traineeships in Developmental, Experimental, and Social Psychology, which provides a stipend of \$2,400 to \$2,800 plus tuition, and the John Wallace Dallenbach Fellowship in Experimental Psychology, which provides a stipend of \$2,700 plus tuition.

New students in this Field are requested to arrive one week before the beginning of classes for an orientation program.

Research is conducted at the following:

- (1) the Social Sciences Building which has special rooms for research in problems of perception and cognition, and well-equipped, one-way observation rooms; a Social Psychology Laboratory well equipped for a variety of experiments, including the capacity to control equipment and perform real-time analyses with a laboratory computer; electrophysiological, histological, and chemical laboratories; major and minor surgery facilities, and facilities for research with laboratory animals; dark rooms, shops, and computer facilities
- (2) the Howard S. Liddell Laboratory of Comparative and Physiological Psychology which includes facilities for research with laboratory animals, birds, and marsupials
- (3) the Center for Improvement of Undergraduate Education which provides facilities for research, curriculum development and evaluation of teaching
- (4) other specialized facilities, both on campus and at various off-campus field stations

The Field of Psychology and the Field of Human Development and Family Studies jointly sponsor a program emphasizing cognitive development. Opportunities for research are provided in a variety of clinical and treatment centers outside the campus. An interdepartmental program in social psychology is also available, sponsored by the Departments of Psychology and Sociology

### Faculty and Specializations

#### Comparative Psychology

Evolution of behavior, animal communication and social behavior, primate behavior, olfaction and animal

## Psychology

### Field Representative

Bruce P. Halpern, 230 Social Sciences Building

### Major and Minor Subjects

Comparative Psychology, Developmental Psychology, Differential Psychology and Psychological Tests, Experimental Psychology, Experimental Psychopathology, History and Systems of Psychology, Mathematical Psychology, Personality and Social Psychology, Physiological Psychology, Psycholinguistics

### Minor Subjects

General Psychology, Industrial Psychology

Applicants are required to submit scores for the Graduate Record Examinations (Advanced Test in Psychology and Aptitude Test) and for the Miller Analogies Test. An undergraduate major in psychology is desirable but not required. Records of applicants are judged on performance in mathematics and natural sciences as well as in psychology. Candidates for a terminal Master's degree are not accepted.

## 62 Vegetable Crops

behavior, discrimination learning and perception:  
W. C. Dilger, R. E. Johnston

### *Developmental Psychology*

Development of language, political socialization, perception and thinking, morality, intellectual development in natural settings, conceptual and affective behavior in infancy, behavioral maturation, animal social behavior, cognitive socialization: H. A. Alker, A. L. Baldwin, C. P. Baldwin, U. Bronfenbrenner, H. Feldman, E. J. Gibson, H. Ginsburg, J. S. Harding, R. E. Johnston, L. C. Lee, E. Lenneberg, H. Levin, M. P. Naditch, M. Potts, H. Ricciuti, R. E. Ripple, G. J. Suci

### *Differential Psychology and Psychological Tests*

Psychometric theory including test theory, scaling, assessment methodology, factor analysis; applications in psychological research and in practical settings:  
H. A. Alker, R. B. Darlington, D. E. Hedlund, J. Millman

### *Experimental Psychology*

The nature of discrimination, attention, the perceiving of the environment, perceptual learning and development, the transmission of information, memory, the development of concepts, the formation of learning sets, classical and instrumental conditioning: J. M. Farber, E. J. Gibson, J. J. Gibson, B. P. Halpern, R. E. Johnston, E. Lenneberg, H. Levin, J. B. Maas, G. W. McConkie, U. Neisser, R. E. Ripple, T. A. Ryan, G. W. Wilcox, D. M. Zahorik

### *Experimental Psychopathology*

Effects of stress upon emotional behavior, disruption of performance, "experimental neurosis," theories of defense, and the relation of these phenomena to human psychopathology: H. A. Alker, J. Doris

### *History and Systems of Psychology*

H. A. Alker, T. A. Ryan

### *Mathematical Psychology*

R. B. Darlington, G. W. Wilcox

### *Personality and Social Psychology*

Aggressive behavior, anxiety and defenses, experimental psychodynamics, personality assessment, emotional communication, character development in the Soviet Union, nonverbal communication, new approaches to observation methodology, political psychology, interpersonal evaluations, guilt and persuasion, attitude change, cross-cultural studies of socialization, face-saving, self-concept, conflict resolution, time perspective: H. A. Alker, U. Bronfenbrenner, B. R. Brown, J. Condry, H. Feldman, L. W. Gruenfeld, J. S. Harding, D. P. Hayes, D. E. Hedlund, S. C. Jones, W. W. Lambert, J. Laws, T. M. Lodahl, A. McIntyre, L. Meltzer, M. P. Naditch, E. R. Ostrander, D. Regan, B. C. Rosen, N. Rosen, K. Weick, L. K. Williams

### *Physiological Psychology*

Brain-behavior relationships, sensory psychophysiology, hormones and behavior, sleep and dreams, hunger and appetite: B. P. Halpern, R. E. Johnston, D. A. Levitsky, E. Lenneberg, J. Maas, D. M. Zahorik

### *Psycholinguistics*

The study of language acquisition; relations between language and other cognitive processes; the study of meaning; process of reading; the biological basis of language: J. Catlin, E. J. Gibson, E. Lenneberg, H. Levin, U. Neisser

## Statistics

(Please see p. 50.)

## Vegetable Crops

### Field Representative

Elmer E. Ewing, 147C Plant Science Building

### Major and Minor Subjects

Vegetable Crops

A good background in biological and agricultural sciences, together with an interest in economic plants is desirable, and farm experience is an advantage.

In addition to the examinations required by the Graduate School, for the Ph.D. degree the Field requires a qualifying examination which is taken early in the program, preferably no later than the second term of residence.

All M.S. and Ph.D. candidates will be encouraged to obtain teaching experience.

Research and study in this Field involve the application of scientific knowledge and methods to the solution of problems in the production, handling, processing, and marketing of vegetables, including potatoes and dry beans. Depending upon the student's interests, it is possible to prepare for careers in such diverse areas as university teaching; international agriculture; applied or basic biological research; agricultural extension; governmental regulatory agencies; or commercial work with agricultural chemicals, food processing, or seed producers.

Facilities include ample greenhouse space; a new bioclimatic laboratory complex; a pilot plant at Geneva; research farms at Ithaca, Geneva, and Riverhead; and laboratories well equipped for physiological, anatomical, genetic, and biochemical investigations. A limited number of assistantships are available to qualified applicants for training in research, teaching, or extension.

### Faculty and Specializations

W. C. Kelly, P. A. Minges, E. B. Oyer, R. F. Sandsted: vegetable crop physiology and production  
D. W. Barton,\* M. H. Dickson,\* G. A. Marx,\* H. M. Munger, R. W. Robinson,\* D. H. Wallace: breeding, genetics, and variety performances  
R. D. Sweet: chemical and biological weed control  
F. M. R. Isenberg: post-harvest physiology, biological aspects of handling and marketing vegetables  
J. D. Hartman: biological and food technological aspects of marketing, objective and subjective measurement of color, flavor, and texture  
R. Sheldrake: greenhouse crops, structures, systems, soil management, and nutrition  
L. D. Topoleski: youth extension work, pollen physiology and incompatibility  
M. T. Vittum:\* climatology and soil-plant-water relationships  
N. H. Peck:\* mineral nutrition, fertilization, and cultural practices  
J. L. Ozbun, S. Shannon:\* biochemistry, nutrition, and physiology  
P. L. Minotti: mineral nutrition, organic soils, lettuce breeding  
S. L. Dallyn (at Riverhead): potatoes (blackspot, storage, sprout inhibitors, cooking quality), other vegetables (cultural methods, fertilization, irrigation, chemical weed control, greenhouse crop production)  
E. E. Ewing: potatoes, especially the interrelationships among plant growth substances, enzyme and nucleic acid metabolism, and changes in plants and tubers

\* Faculty of the New York State Agricultural Experiment Station in Geneva.



## Veterinary Medicine

### Field Representative

A. J. Winter, E317 Veterinary College

### Major and Minor Subjects

Animal Physiology, Immunochemistry, Parasitology, Pathogenic Bacteriology, Physical Biology (including Radiation Biology), Veterinary Anatomy, Veterinary Medicine, Veterinary Obstetrics and Diseases of the Reproductive Organs, Veterinary Pathology, Veterinary Pharmacology, Veterinary Surgery, Veterinary Virology

An applicant from a country other than the United States or Canada is requested to submit the results of the Graduate Record Examinations Aptitude Test if feasible; otherwise, he may submit instead the results of the College Entrance Examination Board Scholastic Aptitude Tests. In the clinical areas, only candidates with the D.V.M. degree are accepted for graduate work.

In addition to the examinations required by the Graduate School, all Ph.D. degree candidates must pass a qualifying examination, usually given during the second semester of work. The Field does not require reading knowledge of a foreign language. It should be noted, however, that the student's Special Committee may enforce such a requirement.

Facilities for graduate study and research in all areas of basic and applied veterinary medicine offer many unique opportunities. In addition to the excellent University libraries, the College has a specialized collection of more than 55,000 volumes and 766 current periodicals. A large and varied clinic representing all domestic animals is available as a source of material. In addition to the animal quarters, pastures and laboratories on the main campus, the College operates several farm and research facilities within close proximity. These include the virus disease laboratories, poultry disease facilities, sheep and cattle disease farms, and the radiation biology laboratory.

Graduate students may work for the M.S. or Ph.D. degree, or the D.Sc. in V.M. (Doctor of Science in Veterinary Medicine). The latter degree is characterized by a professional rather than a research objective. (See the *Announcement of the New York Veterinary College* for a full description of the requirements.) A student who holds the D.V.M. degree from a recognized college in the United States or Canada may transfer one year's residence credit for that work toward the Ph.D. degree.

### Faculty and Specializations

#### Anatomy

Neurology of mammalian animals: J. F. Cummings, A. de Lahunta

Mammalian embryology, teratology, and development: H. E. Evans

Gross and microscopic functional anatomy of the digestive system, particularly of ruminants: J. F. Cummings, R. E. Habel, W. O. Sack

Gross comparative anatomy: H. E. Evans

Applied anatomy of domestic mammals: R. E. Habel

#### Avian Diseases

Parasitology, pathogenic bacteriology, pathology, virology: B. W. Calnek, J. Fabricant, S. B. Hitchner, P. P. Levine, M. C. Peckham

#### Large Animal Medicine, Obstetrics, and Surgery

Mastitis, especially in the field of immunochemistry, reproductive diseases of cattle, and nutrition in relation to bone and joint diseases of horses: J. Bentinck-Smith, D. D. Delahanty, J. R. Duncan, H. O. Dunn, F. H. Fox, J. C. Geary, N. B. Haynes, H. F. Hintz, R. F. Kahrs,

K. McEntee, N. L. Norcross, H. F. Schryver, J. B. Tasker, B. C. Tennant, J. T. Vaughan, A. Winter

#### Microbiology

Pathogenic bacteriology, immunology, immunochemistry, and virology: M. J. G. Appel, J. A. Baker, S. G. Campbell, L. E. Carmichael, J. H. Gillespie, R. F. Kahrs, K. M. Lee, G. Lust, N. L. Norcross, G. C. Poppensiek, F. W. Scott, B. E. Sheffy, A. Winter

#### Pathology

Necropsy pathology, surgical pathology, nutritional pathology, parasite ecology, electron microscopy, laboratory animal disease, cancer research: C. I. Boyer, L. Coggins, J. R. Georgi, J. M. King, L. P. Krook, F. M. Noronha, J. E. Post, L. T. Pulley, C. G. Rickard, J. N. Shively, J. H. Whitlock

#### Physical Biology

Fission product metabolism; biological effects of radiation; mineral metabolism; transport processes; central nervous system physiology; receptor physiology; use of radioisotopes in biological and clinical research; problems of radioactive contamination of the food chain; biological costs of energy production: A. P. Casarett, C. L. Comar, P. H. Craig, E. L. Gasteiger, F. A. Kallfelz, F. W. Lengemann, L. L. Nangeroni, D. N. Tapper, J. C. Thompson, R. H. Wasserman

#### Physiology, Biochemistry, and Pharmacology

Enzyme kinetic studies, endocrine regulation of metabolism, absorption from the digestive tract, carbohydrate and fat metabolic studies in ruminants, chelation of heavy metals in the animal body, chelate toxicity, electrolyte metabolism in digestive tract disease in ruminants, gastric blood flow: W. J. Arion, A. L. Aronson, E. N. Bergman, A. Dobson, T. R. Houpt, W. S. Schwark, A. F. Sellers, C. E. Stevens, J. F. Wootton

#### Small Animal Medicine and Surgery

General and advanced canine medicine, general canine surgery, canine orthopedic surgery, canine thoracic surgery, canine ophthalmology, breeding diseases of small animals: S. I. Bistner, R. W. Kirk

## Zoology

### Field Representative

William A. Wimsatt, G-45 Emerson Hall

### Major and Minor Subjects

Animal Cytology, Comparative and Functional Anatomy, Ecology, Embryology, Histology, Invertebrate Zoology

Applicants must submit scores of the Graduate Record Examinations Aptitude and Advanced Biology Tests.

All applicants should have completed the equivalent of a college major in zoology, with some foundation in the particular phase of zoology they desire to pursue, and should have taken courses in organic chemistry, elementary physics, and calculus.

Proficiency in French, German, or Russian (in addition to English) is required of all candidates for the Ph.D. degree, unless the candidate's Special Committee recommends substitution of another language.

All candidates entering a Ph.D. program will take a prescription examination not later than the beginning of their second term of residence.

All Ph.D. candidates are expected to perform in a teaching capacity for a minimum of two semesters.

There are excellent opportunities for study and research in most phases of zoology, particularly in the descriptive

and experimental aspects of the following special subjects: comparative and vertebrate anatomy with emphasis on the functional approach, developmental biology, general ecology, cytology, histology and descriptive embryology, invertebrate zoology, parasitology, and vertebrate zoology.

### **Faculty and Specializations**

- J. M. Anderson: general and comparative anatomy of invertebrates, with emphasis on functional histology and histochemistry of organ systems
- A. W. Blackler: origin of sex cells and nucleocytoplasmic interaction in development
- S. E. Bloom: cytology and cytogenetics of avian species, applications of cytochemistry and cytophotometry in the animal and plant sciences
- T. J. Cade: environmental biology of vertebrates, ornithology, biology of raptorial birds
- L. C. Cole: general ecology, with special emphasis on population phenomena and the mathematical theory of populations
- H. E. Evans: comparative vertebrate morphology, the prenatal development of the dog
- K. A. Feeny: developmental biology, developmental neurobiology
- P. W. Gilbert: vertebrate functional anatomy (correlation of habits and activities of vertebrates with their morphology), biology of elasmobranch fishes with emphasis on reproductive patterns and sense organs
- R. L. Hallberg: molecular aspects of development with particular reference to biochemical processes during amphibian oogenesis
- J. W. Hudson: environmental physiology, comparative physiology, respiration, hibernation, temperature regulation (particularly of mammals)
- W. A. Wimsatt: vertebrate histology with emphasis on histophysiological, histochemical, and ultrastructural aspects of reproduction, digestion, placentation, and hibernation

## **Physical Sciences**

**Aerospace Engineering, Agricultural Engineering, Applied Mathematics, Applied Physics, Astronomy and Space Sciences, Chemical Engineering, Chemistry, Civil and Environmental Engineering, Computer Science, Electrical Engineering, Environmental Quality, Geological Sciences, Materials Science and Engineering, Mathematics, Mechanical Engineering, Medical Sciences (Graduate School of Medical Sciences), Nuclear Science and Engineering, Operations Research, Physics, Statistics, Theoretical and Applied Mechanics, Water Resources**

## **Aerospace Engineering**

### **Field Representative**

A. R. George, 283A Grumman Hall

### **Major Subject**

Aerospace Engineering

### **Minor Subjects**

Aerospace Engineering, Aerodynamics

Applicants should hold a bachelor's degree in engineering or the physical sciences. It is not recommended that candidates apply for admission at mid-year, except in unusual cases.

The language requirement for the Ph.D. is one language in addition to the candidate's native language—French, German, Russian, or English.

Candidates who do not already hold a master's degree are encouraged to matriculate first as candidates for the professional degree, Master of Engineering (Aerospace), (see the *Announcement of the College of Engineering*). No final comprehensive examination is required for this Master's degree.

In this Field emphasis is placed on basic aerospace sciences rather than proficiency in present-day techniques. Current research is concerned with fundamental problems in the dynamics of fluids, including applications to plasmas, ferromagnetic fluids, and coupled chemical reactions at high temperature. The staff is also actively engaged in studies of the sonic boom and associated problems concerned with high-performance aircraft, as well as research in chemical kinetics and research in structures and materials.

### **Faculty and Specializations**

- P. C. T. de Boer, E. L. Resler, Jr.: dynamics of gases at high temperatures and applications to gas lasers, interaction between radiation and flow fields
- P. L. Auer, W. R. Sears, D. L. Turcotte: magnetohydrodynamics, continuum plasma physics
- G. S. Ludford: mathematical theory of magnetohydrodynamics and fluid dynamics
- A. R. George, A. R. Seebass, S. F. Shen: rarefied-gas dynamics, hypersonics, basic fluid mechanics, advanced aerodynamics
- W. R. Sears, A. R. George: noise generation by aerodynamic sources
- R. H. Gallagher: structures and materials
- D. L. Turcotte: geological fluid flows
- E. L. Resler, Jr.: ferrohydrodynamics

## **Agricultural Engineering**

### **Field Representative**

Ronald B. Furry, 220 Riley-Robb Hall

### **Major and Minor Subjects**

Agricultural Engineering, Agricultural Structures, Agricultural Waste Management, Electric Power and Processing, Power and Machinery, Soil and Water Engineering

Ph.D. candidates are required to select one major subject from the above list, and two minor subjects, at least one of which must be outside the Field. M.S. candidates are required to take agricultural engineering as their major subject and to select one minor outside the Field.

The professional degree of Master of Engineering (Agricultural) is intended primarily for those students who plan to enter engineering practice. This program is intended to develop the student's background in engineering design as well as strengthen his fundamental engineering base. For further information, see the *Announcement of the College of Engineering*.

The professional degree of Master of Professional Studies (Agriculture) is intended for those who wish to further their training for practitioner-type work in related agricultural and life science professions, and who do not intend to become involved in design and research.

An applicant must have a baccalaureate degree in an area of engineering, physical science, or biological science. Deficiencies in undergraduate training must be satisfied early in the advanced degree program.

Applicants requesting fellowships are strongly urged to submit scores of the Graduate Record Examinations Aptitude and Advanced Engineering Tests.

## Faculty and Specializations

For further information about current research projects, a prospective student should write to the Field representative.

### *Agricultural Engineering*

All graduate faculty members: bioengineering, engineering properties of biological materials, materials handling, and all other subject areas listed below

### *Agricultural Structures*

R. B. Furry, R. T. Lorenzen, D. R. Price, N. R. Scott: structural analysis and design; production systems analysis, design, and synthesis; structural-biological relationships; environmental composition and control; biological response to environment; thermodynamic and heat transfer processes

### *Agricultural Waste Management*

D. A. Haith, R. C. Loehr, D. C. Ludington: biological, physical, and chemical waste treatment, moisture removal, odor control, waste handling, source control of wastes, waste management systems, waste characterization

### *Electric Power and Processing*

R. B. Furry, R. W. Guest, D. R. Price, N. R. Scott, E. S. Shephardson: electrical and electronic control systems, processing of agricultural materials, application of electromagnetic radiation to agriculture, systems modeling and analysis

### *Power and Machinery*

J. R. Cooke, O. C. French, R. W. Guest, W. W. Gunkel, E. D. Markwardt, W. F. Millier, G. E. Rehkugler, E. S. Shephardson: agricultural machinery design and development, terramechanics, crop harvesting, handling and processing systems, metering and distribution of agricultural chemicals, physical and biological factors pertaining to machine design such as soil mechanics in relation to seedling development and crop establishment

### *Soil and Water Engineering*

R. D. Black, G. Levine, J. W. Spencer: surface water hydrology, drainage, irrigation, soil-plant-water relationships, hydraulics, erosion control, tropical water management, and secondary road systems

### *Agricultural Engineering (minor subject area only)*

E. W. Foss, F. G. Lechner: agricultural mechanization and mechanization teaching, safety engineering, rural resource development

## Applied Mathematics

### Field Representative

William F. Lucas, 275 Olin Hall

### Major Subject

#### Applied Mathematics

The graduate program in Applied Mathematics is based on a solid foundation in pure mathematics; it includes a thorough grounding in mathematical methods and studies of subject areas in which significant applications of mathematics are made. A new program of study in the area of mathematical biology has recently been initiated through the help and cooperation of the Biomathematics Group at Cornell Medical School.

A candidate for the Ph.D. degree must demonstrate reading knowledge of French, German, or Russian.

The thesis must be a mathematical contribution toward the solution of a problem arising outside mathematics.

## Faculty and Specializations

L. J. Billera: game theory, combinatorial mathematics  
H. D. Block: nonlinear mechanics, automata, functional analysis  
J. H. Bramble: numerical analysis, partial differential equations  
J. R. Bunch: numerical analysis  
H. J. Carlin: microwave and network techniques  
R. L. Constable: computational complexity, program structure  
J. E. Dennis: numerical analysis, mathematical programming  
J. C. Dunn: optimal control theory  
R. Farrell: probability and statistics  
N. J. Friedman: numerical analysis, partial differential equations  
M. E. Fisher: foundation and applications of statistical mechanics  
W. H. J. Fuchs: mathematical methods of physics  
D. R. Fulkerson: networks, programming, combinatorics  
L. Gross: analysis, mathematics of quantum theory  
F. Jelinek: information theory, coding, communication networks, automata  
H. Kesten: probability theory  
J. C. Kiefer: probability and statistics  
J. A. Krumhansl: mathematical physics, microscopic processes, macroscopic descriptions  
S. Leibovich: fluid dynamics, magnetohydrodynamics  
S. Levin: mathematical analysis, partial differential equations, biomathematics  
R. Liboff: kinetic theory, plasma physics  
W. F. Lucas: game theory, combinatorial mathematics  
G. S. S. Ludford: fluid mechanics, magneto-fluid dynamics  
J. J. More: numerical analysis, nonlinear functional analysis  
A. Nerode: mathematical logic, recursive functions and computability, algebra, automata  
L. E. Payne: partial differential equations  
N. U. Prabhu: stochastic processes, queues and inventories, reliability  
S. Robinow: blood flow, cell proliferation  
E. E. Salpeter: theoretical astrophysics, nuclear theory, statistical mechanics  
A. H. Schatz: partial differential equations  
W. R. Sears: aerodynamics, magneto-fluid dynamics  
A. R. Seebass: aerodynamics, fluid mechanics  
S. F. Shen: aerodynamics, rarefied gasdynamics  
F. L. Spitzer: probability theory and analysis  
B. Widom: physical chemistry, statistical mechanics

## Applied Physics

### Field Representative

John Silcox, Clark Hall

### Major and Minor Subject

#### Applied Physics

Graduate study in the Field offers the opportunity to achieve proficiency in physics, mathematics, and applied science. Applied physics is particularly suitable for students preparing for a scientific career in areas of applied science based on principles and techniques of physics and in associated areas of physics.

A student may choose for specialization and thesis research any subject compatible with an approach based on the application of principles of physics and mathematics.

Current areas of advanced study and research include: applied theoretical physics, biophysics, chemical physics, cryogenics, physics of fluids, nuclear and reactor physics, optics, plasma physics, radiation and matter, solid state

## 66 Chemical Engineering

physics and materials science, space physics, and surface physics. Additional details about current programs are given in brochures obtainable from the Field representative.

Students in Applied Physics usually receive some sort of financial aid during their entire graduate study program, including summers. However, financial aid for a foreign student is not usually available during his first year. Most students serve as research assistants at least during the period of thesis research.

For applicants for the M.S. or Ph.D. degree program, undergraduate preparation in physics or another physical science, or in an engineering field with strong emphasis on mathematics and modern physics, provides appropriate preparation. Submission of Graduate Record Examinations scores is strongly suggested.

In addition to the examinations required by the Graduate School, every student in the Ph.D. program takes a written qualifying examination, covering the core course program, after three semesters of graduate study.

A professional degree program leading to the degree of Master of Engineering (Engineering Physics) offers the student the opportunity to master advanced topics in physics and extend his skill in his chosen engineering specialties.

### Faculty

D. Ast, P. L. Auer, J. M. Ballantyne, R. W. Balluffi, B. W. Batterman, S. H. Bauer, J. M. Blakely, R. A. Buhrman, D. D. Clark, R. K. Clayton, T. A. Cool, P. C. T. de Boer, F. D. Drake, L. F. Eastman, M. E. Fisher, H. H. Fleischmann, P. L. Hartman, M. O. Harwit, B. L. Isacks, H. H. Johnson, E. J. Kramer, J. A. Krumhansl, A. F. Kuckes, B. R. Kusse, C. A. Lee, A. Lewis, C. Li, R. L. Liboff, R. V. E. Lovelace, R. McFarlane, P. R. McIsaac, M. Nelkin, J. E. Oliver, E. Ott, E. L. Resler, Jr., T. N. Rhodin, A. L. Ruoff, M. M. Salpeter, D. N. Seidman, B. M. Siegel, J. Silcox, R. Spanswick, R. N. Sudan, C. L. Tang, D. L. Turcotte, W. W. Webb, C. B. Wharton, G. J. Wolga

## Astronomy and Space Sciences

### Field Representative

Carl Sagan, 302 Space Sciences Building

### Major and Minor Subjects

Astronomy, Astrophysics, Magnetohydrodynamics, Planetary Studies, Radiophysics, Space Sciences (General)

Students are admitted to this Field with a strong background in astronomy, electrical engineering, engineering physics, mathematics, or physics. The Graduate Record Examinations are required and often are of great help in admitting outstanding students from less known institutions.

### Research Opportunities

Members of the staff are particularly interested in directing graduate research in the following subjects.

Astronomy and astrophysics: cosmic rays, cosmology, dynamics of the interstellar gas, solar system dynamics and magnetohydrodynamics, theory of stellar structure, stellar evolution, nuclear astrophysics, stellar statistics, gravitational theory, X ray sources, chemistry of the interstellar medium

Atmospheric and ionospheric radio investigations: dynamics of the atmosphere and ionosphere; incoherent electron scattering; refraction, scattering, attenuation due to the inhomogeneous nature of the troposphere and ionosphere; propagation of radiowaves in ionized media

Radio astronomy: distribution and classification of radio sources; radar investigations of the moon and planets; solar radio observations; studies of gaseous nebulae; interstellar radio lines; radiogalaxies, quasars, pulsars  
Space vehicle instrumentation: instrumentation relating to lunar and planetary exploration; magnetic field measurements; tenuous gas and particle flux measurements; infrared observations from rockets  
Infrared astronomy: studies of dust clouds, ionized hydrogen regions and cosmic background; development of novel spectrometric techniques  
Lunar studies: simulations of the lunar surface; analysis of samples returned by Apollo crews; spacecraft investigations of the moon; studies of the lunar interior and origin  
Planetary studies: observational, theoretical, and laboratory studies of planetary atmospheres and surfaces; observations from high altitude aircraft; spacecraft investigations especially forthcoming Mariner, Viking, and earth orbital missions; exobiology, and prebiological organic chemistry; dynamics of planetary atmospheres

Graduate students in this Field may be connected with the Cornell University Center for Radiophysics and Space Research, which possesses or is planning important facilities for geophysical and solar system investigations both by radio methods and by space vehicle instrumentation. The Center operates the Infrared Laboratory, the Lunar Laboratory, and the Laboratory for Planetary Studies. Center personnel use large optical telescopes in the American southwest, and Cornell is a charter member of the consortium organizing the proposed 150-inch telescope of New York State Universities. Students may also be connected with the Cornell-operated National Astronomy and Ionosphere Center, Arecibo, Puerto Rico, the largest radio-telescope in the world. Students often conduct thesis research at Arecibo.

The Cornell-Sydney University Astronomy Center, an international cooperative venture, provides students and faculty members of the two universities with an opportunity to work together in the field. The Sydney University facilities include the Criss-Cross and Mills Cross radio telescopes, the stellar intensity interferometer, detectors for very high energy cosmic rays, and plasma and nuclear physics laboratories. Further details of these organizations and facilities can be obtained by writing to the Secretary, Cornell University Center for Radiophysics and Space Research, Space Sciences Building, Cornell University, Ithaca, New York 14850.

### Faculty

R. Bolgiano, N. M. Brice, F. D. Drake, D. T. Farley, P. Gierasch, T. Gold, K. I. Greisen, T. Hagfors, M. O. Harwit, J. R. Houck, D. L. Jauncey, F. Jelinek, R. L. Liboff, G. H. Morrison, E. L. Resler, C. Sagan, E. E. Salpeter, R. N. Sudan, Y. Terzian, R. Wagoner

## Atmospheric Science

(Please see Meteorology in the Field of Agronomy on p. 51.)

## Chemical Engineering

### Field Representative

George F. Scheele, 244 Olin Hall

### Major and Minor Subjects

Biochemical Engineering, Chemical Engineering (General), Chemical Microscopy, Chemical Processes and Process Control, Materials Engineering, Nuclear Process Engineering



Applicants must have completed satisfactorily the equivalent of the fundamental work required by an accredited curriculum in chemical engineering. Outstanding students with an undergraduate major in chemistry will also be considered; they will normally require an extra year of residence.

Chemical Engineering (General), is required of all students, either as a major or as a minor. Candidates are expected to pursue study and research that will give them a deeper comprehension of the basic and applied sciences and will develop initiative, originality, and creative ability. Theses may involve either experimental research or special projects in such subjects as design, economics, and mathematical analysis. There is no language requirement for students majoring in chemical engineering.

### Faculty and Specializations

- J. L. Anderson: transport through membranes, biochemical and biological engineering
- K. B. Bischoff: medical and microbiological engineering, chemical reaction engineering
- G. G. Cocks: light and electron microscopy, properties of materials, solid-state chemistry, crystallography
- V. H. Edwards: kinetics and process control in fermentation
- R. K. Finn: continuous fermentation, agitation and aeration, processing biochemicals, electrophoresis, microbial conversion of hydrocarbons
- P. Harriott: kinetics and catalysis, process control, diffusion in membranes and porous solids
- J. E. Hedrick: economic analyses and forecasts, new ventures development
- F. Rodriguez: polymerization, properties of polymer systems
- G. F. Scheele: hydrodynamic stability, coalescence, fluid mechanics of liquid drops and jets, convection-distorted flow fields
- J. C. Smith: conductive transfer processes, heat transfer, mixing, mechanical separations
- J. F. Stevenson: fluid mechanics, polymer rheology, bioengineering
- R. G. Thorpe: phase equilibria, fluid flow, kinetics of polymerization
- R. L. Von Berg: liquid-liquid extraction, reaction kinetics, effect of radiation on chemical reactions
- H. F. Wiegandt: crystallization, petroleum processing, saline-water conversion, direct contact heat transfer
- C. C. Winding: degradation of polymers, polymer compounding, filler-polymer systems, differential thermal analysis
- R. York: molecular sieves, chemical market analyses, chemical economics, process development, design, and evaluation

## Chemistry

### Field Representative

W. T. Miller, 350 Baker Laboratory

### Major and Minor Subjects

Analytical Chemistry, Bioorganic Chemistry, Biophysical Chemistry, Inorganic Chemistry, Organic Chemistry, Physical Chemistry, Theoretical Chemistry

With the consent of his Special Committee, a student may elect one or two minors from the above list or from another Field.

Applicants for the M.S. or Ph.D. program should have the equivalent of an A.B. degree with a major in chemistry, including courses in general chemistry, mathematics, organic chemistry, physical chemistry, physics, qualitative and quantitative analysis. Unusually promising students may be admitted with deficiencies in undergraduate training, but will have to make up the deficiencies. Applicants should take the Graduate Record

Examinations Aptitude (Verbal and Quantitative) Tests and Advanced Test in Chemistry.

The program of graduate study is designed to give broad training in the fundamental knowledge of chemistry and in methods of research. A graduate student will ordinarily pursue these objectives by taking advanced courses, by participation in organized and informal seminars and discussions with his associates and faculty members, and by carrying out and reporting on a research project in his major subject.

Graduate students are encouraged to carry on research during the summer, and financial support is normally available.

Entering graduate students are required to register with the Department of Chemistry on the registration days at the beginning of their first term. They will consult with the chairman of the Department and with their temporary Special Committees.

Proficiency tests in analytical, inorganic, organic, and physical chemistry will be required of all entering M.S. or Ph.D. candidates. These tests are given a few days before registration for the fall term. Results will be used to help the student's Special Committee plan his program. Low marks in one or more of the tests may require enrollment in elementary courses.

Two years of satisfactory performance as a teaching assistant are required of all candidates for an advanced degree.

Organic chemistry majors are required to pass a reading examination in German or, with permission, Russian; individual major advisers in other chemical disciplines may require a language of their students.

In addition to the examinations required by the Graduate School, students majoring in organic chemistry are required to pass eight cumulative examinations offered approximately monthly throughout the year. Students making normal progress toward the Ph.D. will typically take sixteen such examinations.

Specific inquiries from prospective graduate students are welcomed and should be addressed to the Field representative or to any member of the faculty. Applications for teaching assistantships should be addressed to the Field representative. A brochure entitled *Graduate Work in Chemistry at Cornell* is available from the Field representative. The brochure states in some detail the varied research interest of the Chemistry faculty.

### Faculty

A. C. Albrecht, S. H. Bauer, C. A. Brown, J. M. Burlitch, W. D. Cooke, V. du Vigneaud, E. L. Elson, R. C. Fay, M. E. Fisher, G. A. Fisk, J. H. Freed, M. J. Goldstein, G. G. Hammes, R. Hoffmann, R. E. Hughes, F. A. Long, G. M. Loudon, F. W. McLafferty, W. T. Miller, G. H. Morrison, R. A. Plane, R. F. Porter, R. R. Rye, H. A. Scheraga, F. R. Scholer, M. F. Semmelhack, A. G. Shultz, M. J. Sienko, D. A. Usher, B. Widom, J. R. Wiesenfeld, C. F. Wilcox, Jr.  
Professor-at-Large: M. Eigen

## Civil and Environmental Engineering

### Field Representative

Wilfried Brutsaert, 271 Hollister Hall

### Major and Minor Subjects

Aerial Photographic Studies\* (M.S. only), Environmental Systems Engineering, Geodetic and Photogrammetric

\* Concentration on Aerial Photographic Studies at the Ph.D. level is offered under the subject Geotechnical Engineering.

Engineering, Geotechnical Engineering, Hydraulics and Hydrology, Sanitary Engineering, Structural Engineering, Structural Mechanics (minor only), Transportation Engineering, Water Resource Systems (Ph.D. only)

For either an M.S. or Ph.D. program, a minor subject may be selected from the above list of civil and environmental engineering majors with the single exception of water resource systems.

A reading knowledge of one foreign language, usually French, German, or Russian, may be required of Ph.D. candidates; this requirement is left to the discretion of each student's Special Committee. Each student in the Ph.D. program must also take a qualifying examination shortly after receiving his M.S.; or, if he comes to Cornell with an M.S., within nine months after arrival.

Additional information is available by writing to the Field Representative, School of Civil and Environmental Engineering. The professional degree of Master of Engineering (Civil) is intended primarily for persons who plan to practice engineering and not for those who expect to enter engineering teaching or research. The professional degree requires a minimum of thirty credit hours of graduate-level work in the principles and practices of the Field. Students may concentrate in one of the areas within Civil and Environmental Engineering. Additional information is available by writing to the Graduate Professional Engineering Programs Committee, 221 Carpenter Hall.

### Research Opportunities

Study and research is usually carried on in one of the major subject areas listed below:

**Aerial Photographic Studies.** The techniques of interpretation of aerial photographs and other remote sensing devices, coupled with ground observations, are used to establish the overall environment and to define the nature of the problems and aid in their solutions.

**Environmental Systems Engineering.** This area involves the application of systems engineering, economic and political theory, and environmental law to public sector problems including environmental quality management, public health services, and other urban and regional planning problems.

**Geodetic and Photogrammetric Engineering.** Research emphasis is on the development of photogrammetric methods for measuring the shape of large surfaces, such as that of the Arecibo Radio Astronomy Telescope, as well as of small surfaces, such as that of the interior of the human eye. The development of methodology for the measurement of earth movements is also being studied. Research is continuing in analytic aerotriangulation.

**Geotechnical Engineering.** This area is concerned with the study of the engineering properties and use of earth materials and with the measurement of the earth and its component parts. It includes soil and rock mechanics, foundation engineering, and subgrades and pavements.

**Hydraulics and Hydrology.** This subject involves the study of fluid mechanics of the environment and the associated application to hydraulics, hydrology, oceanography, and meteorology as related to the wet earth and the atmosphere.

**Sanitary Engineering.** Sanitary (environmental quality) engineering is concerned with the protection and management of the quality of the air-land-water environment for the benefit of society. Degree programs emphasize biological, chemical, and physical phenomena and engineering principles, laboratory and computational skills, and their application to the analysis of relevant problems.

**Structural Engineering.** This area embraces not only the more conventional aspects of civil and environmental engineering design but also other structural work, such as aeronautical and space structures, nuclear engineering structures, tanks, bins, pressure vessels, antenna towers, and the like. Emphasis is placed on the common fundamental background, theoretical and experimental, of all structural engineering.

A brochure on structural engineering at Cornell University is available from the School of Civil and Environmental Engineering, Hollister Hall.

**Transportation Engineering.** The focus of this subject is on the quantitative analysis of problems in the area of transportation planning and operations, both for the private and the public sector.

**Water Resource Systems.** This area involves the development and application of mathematical and computer techniques for defining and evaluating alternative design and/or management policies for water and waste-water treatment facilities, multipurpose reservoir systems, regional water quality control, power plant siting and capacity, water pricing, and other institutional and structural measures for controlling and utilizing water resources.

### Faculty and Specializations

V. C. Behn: sanitary engineering  
D. J. Belcher: aerial photographs  
P. L. Bereano: environmental law and planning  
W. Brutsaert: hydrology  
L. B. Dworsky: water resources, pollution control  
G. P. Fisher: environmental systems  
R. H. Gallagher: structures  
C. D. Gates: sanitary engineering  
P. Gergely: structures  
D. P. Greenberg: structures  
D. A. Haith: water resource systems  
J. N. Kay: soil mechanics  
A. W. Lawrence: sanitary engineering  
T. Liang: aerial photographs, physical environment  
J. A. Liggett: hydraulics  
R. C. Loehr: agricultural wastes  
D. P. Loucks: water resource systems  
W. R. Lynn: environmental systems  
G. B. Lyon: surveying  
W. McGuire: structures  
A. J. McNair: geodesy-photogrammetry  
A. H. Meyburg: urban transportation and planning  
A. H. Nilson: structures  
T. Pekoz: structural engineering, experimental research  
D. A. Sangrey: soil mechanics  
R. G. Sexsmith: structures  
R. E. Schuler: economics  
C. A. Shoemaker: applied mathematics  
F. O. Slate: engineering materials  
S. Stidham, Jr.: environmental systems  
P. R. Stopher: urban transportation and planning  
R. N. White: structures  
G. Winter: structures

## Computer Science

### Field Representative

David Gries, Upson Hall

### Major and Minor Subjects

Computer Science, Information Processing, Numerical Analysis, Theory of Computation

Applicants are expected to have had significant experience in programming a digital computer and appropriate background in the particular major subject chosen to permit immediate enrollment in graduate-level courses.

A candidate for the degree of Ph.D. must demonstrate reading ability in one language besides English: French, German, Russian, or any language in which there exists a substantial body of literature in the area of the student's doctoral thesis.

### Aims and Operations of the Field

The field is concerned with fundamental knowledge in automata, computability, and programming languages and systems programming, as well as with subjects such as numerical analysis and information processing, which underlie broad areas of computer applications. A graduate student should consider a major in computer science if he is primarily interested in the general aspects of computational processes, both theoretical and practical, e.g., theory of algorithms, methods by which algorithms are implemented on a computer, and information structures.

### Computing Facilities

The principal computing facility at Cornell is an IBM 360 Model 65, located in Langmuir Laboratory on the periphery of the campus and directly linked to satellite computers at three campus locations. The Engineering College and the Department of Computer Science are served through a satellite station in Upson Hall and by a number of teletypewriter terminals. An IBM 1800 computer is also available to provide an analog-digital interface and graphical display equipment.

A booklet describing graduate work in computer science can be obtained by writing to the Field representative.

### Faculty and Specializations

Numerical analysis: J. H. Bramble, J. R. Bunch, J. E. Dennis, J. Moré, R. J. Walker  
Programming languages and systems: R. W. Conway, D. Gries, W. L. Maxwell, C. G. Moore, J. H. Williams  
Theory of computation: R. L. Constable, J. Hartmanis, A. Nerode  
Theory of algorithms: J. E. Hopcroft, E. Horowitz, R. Tarjan  
Information organization and retrieval: G. Salton  
Systems and control theory: C. Pottle  
Adaptive systems: H. D. Block

## Electrical Engineering

### Field Representative

Donald T. Farley, 230 Phillips Hall

### Major and Minor Subjects

Electrical Engineering, Electrical Systems, Electrophysics

Applicants should have had the equivalent of the fundamental work required by an accredited undergraduate curriculum in the area of his major subject.

Candidates for the Ph.D. degree are required to complete successfully a written qualifying examination.

The Master of Engineering (Electrical) degree program is open to persons who hold a baccalaureate (or equivalent) degree in engineering or science which is considered appropriate as a background for professional graduate study in the Field. The function of this graduate program is to develop in depth knowledge and understanding in subject areas that support the practice of electrical engineering. For further information, see the *Announcement of the College of Engineering*.

Fellowships available for electrical engineering degree candidates include: John McMullen Graduate Fellowships, IBM Fellowship, NDEA IV Fellowships, and Schlumberger Foundation Fellowship.

There are also a number of teaching and research assistantships available.

### Research Opportunities

**Electrical Engineering.** This area includes electrical measurements; instrumentation; and the conversion, transmission, and control of electrical energy. Some typical research projects include the design of an electric automobile, a radio deer-tracking system, and a remotely controlled vehicle for exploring planetary surfaces. Other work is closely related to research in the systems or electrophysics areas.

**Electrical Systems.** Research in systems is concentrated in the areas of control theory, information and decision theory, and network analysis and design. Topics studied include: stochastic control; optimization and approximation techniques; distributed parameter systems; the simulation of systems; information coding and transmission; random signal processing; decision making; pattern classification; the analysis, synthesis, and computer aided design of timevarying, nonlinear, active, and/or distributed parameter networks; digital and switching circuits; and biological systems.

**Electrophysics.** This category includes all research in which the primary concern is the interaction of electromagnetic fields with materials in the solid, liquid, gaseous, or plasma state, including high energy and geophysical plasmas such as the ionosphere and magnetosphere. Electromagnetic wave propagation and scattering, magnetohydrodynamics, electron beam devices, quantum electronics and lasers, solid state physics, high frequency phenomena in semiconductors, semiconductor devices, and bioelectronics are among the topics studied.

### Faculty

P. D. Ankrum, J. M. Ballantyne, T. Berger, H. D. Block, R. Bolgiano, N. M. Brice, N. H. Bryant, R. R. Capranica, H. J. Carlin, G. C. Dalman, L. F. Eastman, W. H. Erickson, D. T. Farley, T. L. Fine, J. Frey, T. Gold, T. Hagfors, J. Hartmanis, F. Jelinek, M. Kim, W. H. Ku, C. A. Lee, R. L. Liboff, S. Linke, R. A. McFarlane, H. S. McGaughan, P. R. McIsaac, J. A. Nation, B. Nichols, R. E. Osborn, E. Ott, C. Pottle, E. L. Resler, Jr., J. L. Rosson, H. G. Smith, R. N. Sudan, G. Szentirmai, C. L. Tang, J. S. Thorp, H. C. Torng, N. M. Vrana, C. B. Wharton, G. J. Wolga, S. W. Zimmerman

## Environmental Quality

### Field Representative

R. C. Loehr, 207 Riley-Robb Hall

### Minor Subject

Environmental Quality

This minor Field offers qualified engineers and scientists an opportunity to broaden their knowledge in physical, chemical, and biological areas related to environmental quality problems and their control. This minor is intended to encourage interdisciplinary study, and students selecting it will take courses in several disciplines with the objective of understanding the environment and its interaction with man. It will include the combination of courses, seminars, and projects considered best for the individual student.

A student seeking a Master's degree will ordinarily take a minimum of three courses for this minor, with the courses being given in at least two areas outside his major field;

## 70 Materials Science and Engineering

and a student seeking a doctoral degree will ordinarily take a minimum of five courses, given in at least two areas outside his major field.

### Faculty

B. E. Dethier, N. C. Dondero, L. B. Dworsky, A. W. Eipper, C. D. Gates, L. S. Hamilton, A. W. Lawrence, R. C. Loehr, D. P. Loucks, D. C. Ludington, W. R. Lynn, R. T. Oglesby, G. W. Olson, D. Pimentel, H. W. Seeley, Jr., J. C. Thompson, Jr., R. R. Zall, P. J. Zwerman

## Geological Sciences

### Field Representative

Jack E. Oliver, 209 Kimball Hall

### Major and Minor Subjects

Economic Geology; Engineering Geology; Environmental Geology; Geobiology, Paleontology, and Stratigraphy; Geochemistry, Mineralogy, Petrology; Geomorphology; Geophysics; Geotectonics and Structural Geology; Marine Geology; Physical Geography; Seismology

### Minor Subjects Only

Pleistocene Geology, Hydrogeology, Sedimentation, Oceanography

Students with undergraduate majors in subjects such as engineering, physics, chemistry, biology, and mathematics, as well as in geology, are encouraged to apply. Prior study of geology is not a requirement for admission.

The program is designed to give the student the opportunity for broad formal training in the basic sciences as well as in the Field and to provide extensive practical experience through research in his specialty. The student has a wide variety of options in the selection of a program which will best suit his interests and talents.

For the master's degree and for the doctoral degree proficiency must be established in French, German, or Russian before the candidate completes the second residence unit.

At the time of entrance to the Field, a general examination covering the candidate's preparatory training may be given by the faculty to assist in planning a program of study.

For the doctoral degree, a qualifying examination is required in addition to the examinations required by the Graduate School. The qualifying examination will determine the applicant's fitness for undertaking advanced studies and will enable the Special Committee to plan a program which will make the student familiar with the requisite knowledge in his chosen area. It must be taken before the end of the second semester in residence.

There are several graduate teaching assistantships available in the Field. Teaching assistants who are doctoral candidates are eligible for special summer awards.

The Eleanor Tatum Long Fellowship is restricted to research in the subject of structural geology and geomechanics.

The Department has several special endowments which may be used to assist graduate students in their research and field work, and some research assistantships are available.

### Master of Engineering

A program is offered in conjunction with the College of Engineering; no thesis is required. A major in an engineering subject is combined with a sequence of courses in Geological Sciences.

## Research and Study Opportunities

The Department conducts a number of research programs in various parts of the world covering a variety of research topics. The list is ever changing, but includes such diverse items as study of sea-floor spreading and plate tectonics on a global scale, observation of current seismic activity in the Tonga-Fiji area, investigation of selected ore deposits in Minnesota, measurement of sea level changes and recent crustal movement in the eastern United States, paleontological problems of New York State and elsewhere, engineering geology of selected localities, mapping in Labrador, field geology in Idaho, and marine studies of areas available to current cruises. Through the resources of the Department and the cooperating faculty of other departments, a wide variety of special and advanced equipment is available.

The Department maintains working agreements with institutions in other parts of the world to facilitate research projects in those areas or to work on materials especially accessible at those bases.

The Paleontological Research Institution, a private research organization, is near the campus, and its facilities are available to the specialized investigator.

The Department has a cooperating agreement with the Museum of Northern Arizona at Flagstaff for accommodating research projects and investigators. The Committee for Labrador Studies has been pursuing research in Labrador for forty years, and projects are in progress on field mapping, glacial geology, and petrography.

The Ithaca region is particularly suited for research in stratigraphy, paleontology, geomorphology, and glacial geology. The nearby Adirondack area is a classic one for studies of igneous and metamorphic petrology, and much of the Appalachian orogenic belt is readily accessible. The Department sees geology as a global science, however, and does not limit its interests to the immediate vicinity of the Ithaca campus.

### Interdisciplinary Studies

The exceptional flexibility of the graduate program at Cornell provides ample opportunity for students of the geological sciences to work in interdisciplinary areas. For example, special arrangements are already available for study of oceanography, marine ecology, water resources, and various branches of applied geological science. Faculty in other departments or divisions offer many interdisciplinary courses such as paleobotany, ecology-systematics, biogeochemistry, limnology, soil genesis, soil mineralogy, aerial photo analysis, fluid dynamics, elasticity, regional planning, hydraulics and hydrology, and materials science and engineering.

### Faculty

A. L. Bloom, J. M. Bird, B. Bonnichsen, B. L. Isacks, G. A. Kiersch, J. E. Oliver, S. S. Philbrick, W. B. Travers, J. W. Wells

## Materials Science and Engineering

### Field Representative

Arthur L. Ruoff, 230 Bard Hall

### Major and Minor Subjects

Materials Science, Materials and Metallurgical Engineering

Students from any undergraduate engineering or physical science program may be accepted. It is recommended, but not required, that applicants submit the results of the Graduate Record Examinations.



## Research and Study Opportunities

The following is a list of current areas of advanced study and research.

Mechanical behavior: crack formation and propagation, embrittlement phenomena, fatigue, composite materials, anelasticity, yield and cold drawing of polymers  
Imperfections in solids: point defects, dislocation mechanics, defect interactions, radiation damage, substructure, structural studies of polymers and biopolymers

Phase transformations: solidification, precipitation, martensite, phase decomposition during sintering  
Surface structure and reactions: solid-liquid and solid-gas interfaces, field ion microscopy, surface diffusion, low-energy electron diffraction

Microprocessing: submicron particle production, submicron grain polycrystalline production, submicron lamellar structures, very thin films

High-temperature materials: composite materials, refractory metals and alloys, sintering of ceramics

High-pressure studies: creep, diffusion, elastic constants, equation of state, synthesis, electrical properties

Electrical and magnetic behavior: superconductivity, semiconductors, NMR, conduction in oxides and amorphous materials, magnetic domain wall motion, photoconductivity

Development of advanced experimental techniques: electron microscopy, x ray, high pressure, crystal growing, purification methods

More detailed information about course programs and research areas is available upon request.

A strong catalyst for the materials research activities at Cornell has been provided by the Materials Science Center, which provides substantial financial assistance for graduate students as well as maintaining central research facilities.

## Professional Degree

The program leading to the professional degree of Master of Engineering (Materials) provides advanced courses designed to enlarge the student's preparation for a career in professional engineering, with less emphasis on research. For further information, see the *Announcement of the College of Engineering*.

## Faculty

D. Ast, R. W. Balluffi, B. W. Batterman, J. M. Blakely, M. S. Burton, P. S. Ho, H. H. Johnson, E. J. Kramer, C. Y. Li, T. N. Rhodin, A. L. Ruoff, S. L. Sass, E. Scala, D. N. Seidman, B. M. Siegel, J. Silcox, F. O. Slate, W. W. Webb

## Mathematics

### Field Representative

W. H. J. Fuchs, 124 White Hall

### Major and Minor Subjects

Algebra, Analysis, Geometry, Mathematics

Prerequisites for admission are a knowledge of advanced calculus (including both theoretical and applied points of view) and modern algebra.

The Field requires a reading knowledge of German or Russian for the Ph.D. degree. There is no formal French requirement, but books and papers in that language will be freely used in all graduate courses, and students can expect to be called upon to read French mathematical texts.

The Field requires teaching experience of all graduate students. Candidates for the Master's degree are expected to obtain some understanding of mathematical thought, ordinarily by taking about twenty-four hours of courses at the graduate level. Qualifications for the Ph.D. degree include a broad acquaintance with the basic subjects of present-day mathematics and a demonstration of ability to do research in one or more branches of mathematics.

All of the three major subdivisions of mathematics (algebra, analysis, and geometry) are well represented at Cornell. The Department is also very strong in logic, probability, and statistics. Additional information about courses, thesis and examination requirements, and research in mathematics is contained in a booklet entitled *Graduate Work in Mathematics at Cornell*, which may be obtained by writing to the Chairman, Department of Mathematics, White Hall. A detailed listing of the research interests of the members of the faculty will be sent with the booklet.

## Faculty

I. Bernstein, J. H. Bramble, K. S. Brown, L. D. Brown, S. U. Chase, M. M. Cohen, R. Connelly, G. Cooke, R. K. Dennis, C. J. Earle, R. H. Farrell, M. E. Fisher, N. J. Friedman, W. H. J. Fuchs, S. Gelbart, L. Gross, R. S. Hamilton, D. W. Henderson, K. Ito, A. Jategaonkar, P. J. Kahn, H. Kesten, J. Kiefer, A. W. Knapp, S. Lichtenbaum, G. R. Livesay, M. D. Morley, A. Nerode, P. Olum, L. E. Payne, R. A. Platek, G. S. Rinehart, A. Rosenberg, O. S. Rothaus, A. H. Schatz, R. B. Schneider, S. Sen, D. A. Singer, F. L. Spitzer, R. S. Strichartz, M. E. Sweedler, A. Torchinsky, R. J. Walker, H. C. Wang, W. C. Waterhouse, J. E. West

## Mechanical Engineering

### Field Representative

Benjamin Gebhart, 224 Upson Hall

### Major and Minor Subjects

Mechanical Design, Thermal Power, Thermal Processes

### Minor Subject

Materials Processing

The applicant for an M.S. or Ph.D. program should have the equivalent of fundamental work required in an accredited undergraduate curriculum in the area of his major work. Those without adequate preparation may be required to make up the deficiency.

For the Ph.D. degree a candidate must demonstrate reading ability in one language in addition to his native language in French, German, Russian, or a language approved by petition to the Field.

In addition to the examinations required by the Graduate School, a Ph.D. degree candidate must take a qualifying examination which may be combined with the examination for the M.S.

Awards restricted to M.S. and Ph.D. candidates majoring in this Field are: Esso Education Foundation Fellowship, John McMullen Graduate Fellowship, Procter and Gamble Fellowship, George Burr Upton Fellowship, Edgar J. Meyer Scholarship, Sibley Scholarship.

### Mechanical Systems and Design

Instruction and research is directed toward the broad area of mechanical design, which includes instrumentation and control, vibration analysis, design optimization, computer-aided design, design procedures, finite element applications, and manufacturing processes. Specific applications to vehicle safety, biomechanics, etc., are

## 72 Nuclear Science and Engineering

emphasized. The laboratory facilities of the Department include equipment for studies of stress, vibration, control, and fatigue. Specialized instrumentation for study of machine and tool forces/temperatures is available.

### Thermal Engineering

Research and instruction are directed toward the study of energy production, transport, and associated environmental interactions; and the fundamental aspects of fluid mechanics, heat transfer, classical and irreversible thermodynamics, and nonequilibrium statistical mechanics. Laboratories equipped with modern and sophisticated instrumentation are available for experimental work. Opportunities exist for students to arrange coordinated programs with such fields as applied physics, nuclear engineering, applied mathematics, mechanics, and aerospace engineering.

### Professional Degree

The degree of Master of Engineering (Mechanical) is a curricular type of professional degree, the general requirements for which are stated in the *Announcement of the College of Engineering*. The program permits emphasis on a particular area, such as: machine dynamics and control, mechanical analysis and development, vehicles and propulsion, propulsion engines, thermal environment, thermal power, thermal processes, manufacturing engineering, and material removal.

### Faculty and Specializations

#### Design

Lubrication: J. F. Booker, R. L. Wehe  
Manufacturing engineering: K. K. Wang  
Product design: K. K. Wang, A. I. Krauter  
Design optimization and reliability: D. L. Bartel, A. I. Krauter, H. N. McManus, Jr.  
Design of components: A. H. Burr, R. M. Phelan  
Vibration and controls: J. F. Booker, R. M. Phelan, R. L. Wehe  
Computer-aided design: D. L. Bartel, J. F. Booker

#### Thermal Processes

Fluid dynamics, including high-temperature and nonequilibrium effects, viscosity, radiative transfer, flow lasers, rotating fluids, buoyancy-induced flows, thermal pollution, air pollution, and plasma processes: T. A. Cool, B. Gebhart, F. C. Gouldin, S. Leibovich, F. K. Moore, K. E. Torrance  
Heat transfer, including stability of convective flows, two-phase flows, boiling heat transfer, ablative heat transfer, combustion processes and fire research: D. Dropkin, B. Gebhart, H. N. McManus, Jr., K. E. Torrance  
Thermodynamics including aspects of classical, statistical, and irreversible thermodynamics of concern in present-day technology: B. J. Conta, T. A. Cool

#### Thermal Power

Direct energy conversion, propulsion and nuclear power problems, use of solar energy, turbomachinery, combustion engines, air conditioning and refrigeration, and heat pumps: B. J. Conta, D. Dropkin, F. C. Gouldin, D. G. Shepherd

## Medical Sciences

(Please see p. 57.)

## Nuclear Science and Engineering

### Field Representative

David D. Clark, Ward Laboratory

### Major Subjects

Nuclear Science, Nuclear Engineering

### Minor Subject

Nuclear Engineering

A bachelor's degree in science or engineering, including one year of advanced calculus and a one-year course in atomic and nuclear physics, is required. Students with less preparation may be admitted but should expect to take longer to complete degree requirements.

For the Ph.D. degree, a reading knowledge of one language other than English is required.

Before the beginning of his second term of graduate study, the Ph.D. student is expected to form his Special Committee, which will then administer an informal oral examination designed to guide his future course of study.

Financial aid, including: teaching or research assistantships, federal traineeships, fellowships, and loans is available to graduate students. For applications to the M.S. or Ph.D. program, no special fellowship forms are required. Applications for admission received before February 1 are reviewed for Cornell Graduate Fellowship awards. Other forms of award are generally considered at this time but may also be awarded as they become available at any time during the year.

Students should also consider applying for fellowships awarded nationally by the National Science Foundation.

Prospective students in the Master of Engineering (Nuclear) degree program who wish to apply for scholarship aid should obtain the appropriate form from the Chairman, Graduate Professional Engineering Programs, 221 Carpenter Hall.

### Research and Study Opportunities

Research groups in nuclear science are currently pursuing studies of nuclear structure, atomic structure, activation analysis, and radiation chemistry.

Current examples of research in nuclear engineering include: experimental and analytical reactor physics; nuclear environmental engineering; reactor plant dynamics and safety; and radiation protection and control.

Basic research in low energy nuclear physics and reactor physics at Cornell is centered at the following facilities of the Ward Laboratory: (1) A TRIGA reactor, with a steady-state power of 100 kilowatts and a pulsing capability of up to 250 megawatts, for activation analysis, solid and liquid state studies, and nuclear physics; (2) Cornell Critical Facility, a "zero power reactor" of very versatile design for basic studies in reactor physics and dynamics; (3) subcritical assemblies for reactor physics investigations; (4) Gamma Cell, a shielded cell with a nominal 10,000-Curie Co<sup>60</sup> gamma-ray source for radiation chemistry and radiation damage studies; (5) 3 MeV accelerator of high current capability for atomic and nuclear structure studies and high intensity monoenergetic neutron production.

The program also permits concentration in radiation protection or nuclear environmental engineering, as well as a minor in radiation biology.

### Professional Degree

This two-term curricular program leading to the degree of Master of Engineering (Nuclear) is intended primarily for individuals who want a terminal professional degree, but it may also serve as preparation for doctoral study in nuclear science and engineering. For further information write to the Nuclear Science and Engineering Field Representative, Ward Laboratory.

## Faculty and Specializations

- K. B. Cady: nuclear engineering, reactor physics, nuclear environmental engineering
- D. D. Clark: nuclear structure, radiation detection, energy conversion
- D. Dropkin: heat transfer, thermal processes
- C. D. Gates: nuclear environmental engineering
- V. O. Kostroun: nuclear and atomic structure, interaction of radiation and matter
- S. Linke: energy conversion
- R. M. Littauer: nuclear instrumentation, pulse electronics
- G. H. Morrison: nuclear chemistry
- M. Nelkin: neutron scattering, transport and kinetic theory
- R. L. Von Berg: radiation chemistry, chemical engineering

## Operations Research

### Field Representative

William L. Maxwell, 366 Upson Hall

### Major and Minor Subjects

Operations Research, Applied Probability and Statistics, Systems Analysis and Design, Industrial Engineering, Information Processing (for M.S. only)

### Appropriate Minor Subjects

The following minor subjects in other Fields have been chosen most frequently in recent years: applied mathematics (Applied Mathematics), computer science (Computer Science), econometrics and economic statistics (Economics), environmental systems engineering (Civil and Environmental Engineering), managerial economics (Business and Public Administration), mathematics (Mathematics), planning theory and systems analysis (City and Regional Planning), and water resources (Water Resources)

Applicants must hold a bachelor's degree in engineering, mathematics, economics, or the physical sciences. Submission of the results of the Graduate Record Examinations is essential for fellowship and assistantship applicants.

A student in a Ph.D. program must demonstrate reading ability in French, German, Russian, or a language approved by petition to the Field.

In addition to the examinations required by the Graduate School, the Field requires a qualifying examination for Ph.D. candidates; this examination is normally taken toward the end of the second term of graduate study at Cornell.

The John McMullen Graduate Fellowship is specifically designated for incoming candidates in this Field.

Further information may be obtained by writing to the Office of the Field Representative.

### Professional Degree

The Master of Engineering (Industrial) program is designed for those primarily interested in becoming proficient in the practice of modern industrial engineering and consists of coordinated course work concentrated on advanced analytical and design techniques. Special emphasis is placed on applications.

Applicants must have a Bachelor's degree in an engineering field. Information and applications for this program may be obtained by writing to Byron W. Saunders, Director of the School of Industrial Engineering and Operations Research, Upson Hall.

### Subject Descriptions

**Operations Research.** The problem areas and techniques of operations research are approached from a highly

analytical viewpoint. Emphasis is placed on constructing appropriate mathematical models to represent various real-life operational systems, and on developing techniques for analyzing the performance of these models. In this way procedures with desirable properties for dealing with such systems are developed. Queuing, inventory, reliability, replacement, and scheduling theories and simulation are employed. Optimization techniques such as mathematical programming (linear, nonlinear, and probabilistic), network flows, combinatorics, and dynamic programming are also used extensively, as are the various techniques of the mathematical theory of games.

The operations research student pursues a course of study and research that emphasizes the use of the mathematical, probabilistic, statistical, and computational sciences in the development of the techniques of operations research. His ultimate goal may range from making a fundamental contribution to the techniques of operations research to applying these techniques to problems in diverse professional fields.

**Applied Probability and Statistics.** This subject of study and research is designed for students having primary interests in the techniques and associated underlying theory of probability and statistics, particularly as they are applied to problems arising in science and engineering. The techniques emphasized are those associated with applied stochastic processes (for example, queuing theory, traffic theory, inventory theory, and time-series analysis) and statistics (including statistical decision theory; the statistical aspects of the design, analysis, and interpretation of experiments, and of ranking and selection theory; reliability theory; statistical quality control; sampling inspection; and acceptance sampling).

Students who elect work in this area are expected to acquire considerable knowledge of the theory of probability and statistics. All students who major in applied probability and statistics are required to minor in mathematics.

**Systems Analysis and Design.** Although the solution of systems problems requires knowledge of underlying theory, the inherent practical limitations of the problem must be understood. Analysis of a system alone is insufficient; alternative solutions must be generated before selecting the one which can best be integrated with other elements of the system. Modeling concepts are equally important, but only when they can produce workable systems. Illustrations of the design of integrated systems can be found in industry, the environment, commerce, and government. A good example is the design of urban traffic control systems. Research activity may involve the developing of new methodology or the synthesizing of new combinations from what is already known. The goal is to improve the understanding of systems or to develop new decision criteria for systems.

**Industrial Engineering.** Studies of the analysis and design of the complex operational systems that occur in industry, particularly in manufacturing, are included in this subject. Plant design, cost analysis and control, and production planning represent some of the major topics. A student is expected to have considerable facility in the modern analytical techniques associated with rational decision making and the establishment of valid design criteria. These techniques are drawn from among inventory theory, queuing theory, mathematical programming, quality control, and computer simulation.

Because the design and operation of modern engineering systems apply to areas other than manufacturing, the use of the word "industrial" should not be considered restrictive. Industrial engineers frequently are employed as systems specialists in commerce, banking, distribution merchandising, and hospital management.

**Information Processing.** Concerned with the design of data systems for the control of complex organizations. It is also concerned with analytical research in the fundamental techniques and problems that underlie such systems—such as questions of file organization, retrieval languages, scheduling of concurrent processes, deadlock and interference, and security and surveillance. Study in this area is administered in close cooperation with the Department of Computer Science (which is also housed in Upson Hall). Students are expected to minor in Computer Science and take substantial coursework in that field (for example, CS 409, 411, 412, 413, 435, 509). The principal campus computing facility is an IBM 360/65. A satellite 360/20, directly connected to the 360/65, is located in Upson Hall. Typewriter terminals are also employed.

### Faculty and Specializations

- R. E. Bechhofer: engineering statistics, design of experiments, ranking and selection procedures
- L. J. Billera: game theory, combinatorial analysis, graph theory
- M. Brown: stochastic processes, time-series analysis
- R. W. Conway: information processing systems, computer science
- P. M. Dearing, Jr.: location theory, operations research
- A. Di Marco: systems engineering, industrial engineering
- M. J. Eisner: mathematical programming, game theory
- D. R. Fulkerson: mathematical programming, network flow theory
- H. P. Goode: manufacturing engineering, industrial statistics, sampling inspection
- J. C. Kiefer: statistical decision theory, optimum experimental design, sequential analysis
- W. F. Lucas: game theory, combinatorial analysis, graph theory
- W. R. Lynn: environmental systems
- W. L. Maxwell: information processing systems, production control, systems simulation
- G. L. Nemhauser: mathematical programming, operations research
- N. U. Prabhu: stochastic processes, queuing theory, storage theory
- S. Saltzman: information processing systems, operations research, econometrics
- B. W. Saunders: facility design, materials handling, manufacturing design
- A. Schultz, Jr.: operations research, systems analysis
- D. G. Severance: information processing systems
- F. L. Spitzer: probability theory
- S. Stidham, Jr.: queuing theory, transportation systems
- H. M. Taylor 3d: applied probability
- L. I. Weiss: statistical decision theory, sequential analysis, nonparametric statistics

## Physics

### Field Representative

Donald R. Yennie, 113 Clark Hall

### Major and Minor Subjects

Physics, Experimental Physics, Theoretical Physics

The graduate physics program at Cornell is designed to give the student adequate background in the concepts and techniques of both theoretical and experimental physics to prepare him for a career at the most advanced level in research or teaching. Although the program focuses on the Ph.D. degree, there are a wide variety of options available to the student during his work at Cornell, both in the final level of achievement and in the area of concentration.

The large majority of entering students have completed an undergraduate physics major program including such courses as analytical mechanics, electricity and magnetism, optics and wave motion, electronics, and atomic physics; some advanced undergraduate laboratory work in physics is also expected. Knowledge of differential equations and of vector calculus is essential.

In the selection of new students, emphasis is on the quality of the undergraduate work and on the promise for graduate work rather than on the extent of undergraduate study in physics and related subjects. Many entering students enroll in one or more undergraduate courses to make up deficiencies.

No foreign language is required either for admission or as a requirement for either a Master's or a Ph.D. degree, but proficiency in at least one foreign language is very desirable.

A copy of the brochure, *Graduate Study in Physics at Cornell*, containing a more detailed description of the program, may be obtained by writing to the Chairman, Department of Physics, Clark Hall.

### Research and Study Opportunities

**Theoretical Physics.** Many-body theory, theory of superconductors, theory of metallic state, superfluidity, statistical mechanics and irreversibility, phonon physics and transport processes, low-temperature physics, electro-dynamic phenomena and defects in solids, plasma physics, dispersion relations and strong interactions, internal symmetries and their connection with strong interaction dynamics, current algebra, quantum electrodynamics, quantum field theory and renormalization, astrophysics, stellar structure.

**Experimental High-Energy Nuclear Research.** Photo-production processes involving intermediate-mass mesons and hyperons, energy levels of excited states of the proton, detailed study of the structure of the proton, synchrotron radiation, gamma ray interactions with matter, Compton scattering, photodisintegration of nuclei, cosmic rays including air showers and methods of detection of neutral primary radiations, properties of elementary particles, and high-energy interactions.

Facilities for research at Cornell include a large machine shop and electronics shop and 12 GEV electron-synchrotron; students may also participate in research with the AGS 30-GEV proton-synchrotron at Brookhaven and the 200 GEV proton-synchrotron at the National Accelerator Laboratory.

**Experimental Atomic and Solid State Physics.** Electrical transport properties of metals and semiconductors, thermal conductivity, phonon physics, electron and nuclear spin resonance, linear and nonlinear optical and ultra-violet spectroscopy, Raman and Brillouin scattering, x-ray spectroscopy, far infra-red spectroscopy, superconductivity, properties of amorphous materials, studies of large molecules of biological interest, and the properties of liquid and solid helium.

In addition to a large machine shop and a glass blowing shop there are available, through association with the Materials Science Center, central facilities for electronics, crystal growing, cryogenics, analytical chemistry, technical operations, high pressure, X ray and metallography, crystal irradiation, and electron microscopy.

### Faculty

V. Ambegaokar, N. W. Ashcroft, K. Berkelman, H. A. Bethe, R. Bowers, A. A. Browman, P. A. Carruthers, D. G. Cassel, G. V. Chester, R. M. Cotts, J. W. DeWire, M. E. Fisher, D. B. Fitch, B. Gittelman, K. Gottfried, K. I. Greisen, L. N. Hand, D. L. Hartill, P. L. Hartman, D. F. Holcomb,



T. Kinoshita, J. A. Krumhansl, D. M. Lee, R. M. Littauer, E. C. Loh, H. Mahr, B. W. Maxfield, B. D. McDaniel, N. D. Mermin, N. B. Mistry, H. F. Newhall, J. Orear, L. G. Parratt, J. Peoples, R. O. Pohl, J. D. Reppy, R. C. Richardson, E. E. Salpeter, A. J. Sievers, R. H. Silsbee, A. Silverman, P. C. Stein, R. M. Talman, D. H. White, J. W. Wilkins, K. G. Wilson, R. R. Wilson, W. M. Woodward, T. M. Yan, D. R. Yennie.

Closely associated with the graduate program in Physics are a number of faculty members in related fields who teach in the graduate courses in Physics or serve as thesis advisers to Physics students. There are also typically several visiting professors and about forty Ph.D. instructors and research associates who rarely serve on Special Committees but with whom the students may work informally.

## Statistics

(Please see p. 50.)

## Theoretical and Applied Mechanics

### Field Representative

Richard H. Lance, 235 Thurston Hall

### Major and Minor Subjects

Solid Mechanics, Space Mechanics, Fluid Mechanics, Mechanics of Materials

The program emphasizes learning of the fundamental principles of science and understanding of the newest developments in engineering. Graduate students may pursue in depth studies in mechanics of particles, rigid and deformable solids, dynamics of liquids and gases, mechanical properties of materials, and other related subjects in physics and mathematics. Current research topics include: (1) solid mechanics—wave propagation in solids, static, and dynamic response of structures, elasticity, plasticity, and continuum mechanics; (2) space mechanics—trajectories and orbits of space vehicles, stability and nonlinear oscillation of particles, celestial mechanics, and bionics and robots; pattern classification; (3) fluid mechanics—Newtonian and non-Newtonian fluids, magnetogasdynamics; (4) mechanics of materials—failure and fracture of solids, static and dynamic properties of composite materials.

The Field admits students with backgrounds in physics, mathematics, and any branch of engineering. Students applying for financial aid are encouraged to submit Graduate Record Examinations scores.

Students enrolled in the Ph.D. program must take a qualifying examination at the end of the first semester in

residence. Each doctoral candidate must demonstrate reading ability in one language other than his native language. The Field also requires teaching experience for all doctoral candidates.

Teaching assistantships and a limited number of research assistantships are available. Applications for assistantships are considered along with the admission to the Field and no separate form is needed.

### Faculty

K. T. Alfriend, H. D. Block, B. A. Boley, J. A. Burns, H. D. Conway, E. T. Cranch, J. C. Dunn, J. T. Jenkins, H. H. Johnson, R. H. Lance, S. A. Levin, G. S. S. Ludford, Y. H. Pao, R. H. Rand, D. N. Robinson, W. H. Sachse

## Water Resources

### Field Representative

Charles D. Gates, 221 Hollister Hall

### Minor Subject

Water Resources

Water Resources is a *minor* Field of concentration at Cornell; consequently a prospective student must first be admitted to a *major* Field of the Graduate School.

Water Resources offers qualified engineers and biological, physical, and social scientists an opportunity to gain breadth of knowledge in water resources planning and management by an interdisciplinary program of study in a minor subject designated as water resources.

The minor will represent for each candidate that combination of courses, seminars and projects, outside his own discipline, which his Special Committee considers most appropriate to the comprehensive aspects of his degree program.

Major subjects are ordinarily chosen from the list below (see index for Field): aerial photographic studies, aquatic ecology, chemical engineering, city and regional planning, economic theory, engineering geology, environmental systems engineering, fishery science, geohydrology and hydrogeology, hydraulics and hydrology, limnology, meteorology, natural resources conservation, operations research, public administration, resource economics, sanitary engineering, soil and water engineering, soil science, water resource systems.

### Faculty

D. J. Allee, R. D. Black, L. B. Dworsky, A. W. Eipper, C. D. Gates, L. S. Hamilton, G. A. Kiersch, G. Levine, D. P. Loucks, W. R. Lynn, P. J. Zwerman

# Administration

## University Administration

Dale R. Corson, President of the University  
Robert A. Plane, University Provost  
W. Donald Cooke, Vice President for Research  
Lewis H. Durland, University Treasurer  
William D. Gurowitz, Vice President for Campus Affairs  
Samuel A. Lawrence, Vice President for Administration  
E. Hugh Luckey, Vice President for Medical Affairs  
Thomas W. Mackesey, Vice President for Planning  
Paul L. McKeegan, Vice Provost  
Arthur H. Peterson, University Controller  
Richard M. Ramin, Vice President for Public Affairs  
Robert F. Risley, Vice Provost  
Neal R. Stamp, Secretary of the Corporation and  
University Counsel

## Graduate School Administration

W. Donald Cooke, B.S., M.S., Ph.D., Dean of the  
Graduate School  
Paul J. Leurgans, B.A., M.S., Ph.D., Associate Dean of the  
Graduate School  
Charlotte M. Young, B.S., M.S., Ph.D., Secretary of the  
Graduate Faculty

## General Committee

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Adrian M. Srb (Member-at-Large), term expires 1973  
Alfred W. Eipper (Member-at-Large), term expires 1975  
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Patricia Carden (Humanities), term expires 1973  
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Kathleen Rhodes (Social Sciences), term expires 1975  
William Hansel (Biological Sciences), term expires 1973  
Neal F. Jensen (Biological Sciences), term expires 1975  
David Dropkin (Physical Sciences), term expires 1973  
David G. Cassel (Physical Sciences), term expires 1975

## University Professors-at-Large

Professors-at-Large are distinguished nonresident members of the University faculty. During short visits to the campus, of up to a month's duration, made at irregular intervals, they hold seminars, give public lectures, and consult informally with students and faculty.

Pierre Aigrain  
Sir Eric Ashby  
Howard M. Brown  
Felix Candela  
Jacques Dréze  
Cora DuBois  
Manfred Eigen  
Northrop Frye  
Ernst H. Gombrich  
Ralph E. Gomory  
Gino Gorla  
J. George Harrar  
L. S. B. Leakey  
Barbara McClintock  
J. Robert Schrieffer  
Mysore N. Srinivas  
Georg Henrik von Wright  
Elizabeth Mary Wilkinson

# Index of Fields of Instruction and Major and Minor Subjects

- Accounting, 37; Hotel, 45
- Administrative Dietetics, 56
- Aerial Photographic Studies, 67
- Aerodynamics, 64
- Aerospace Engineering, 64
- African and Afro-American Studies, 35
- Africana Studies, 35
- Agricultural Economics, 35, 36
- Agricultural and Occupational Education, 42
- Agricultural Engineering, 64
- Agricultural: International Development, 47;  
Structures, 64; Waste Management, 64
- Agronomy, 51
- Algebra, 71
- American: Art, 31; History, 30; Literature, 28;  
Politics, 44; Studies, 28, 30
- Analysis, 71; Numerical, 68; Systems and Design, 73
- Ancient: Art and Archaeology, 31; History, 27, 30;  
Philosophy, 27
- Animal Breeding, 51
- Animal: Cytology, 63; Genetics, 51; Nutrition, 51;  
Physiology, 63
- Animal Science, 51
- Anthropology, 36; Applied, 36; Physical, 36; Social, 36
- Apiculture, 54
- Applied Mathematics, 65
- Applied Physics, 65
- Applied Probability and Statistics, 73
- Applied Welfare Economics and Public Policy, 40
- Aquatic: Ecology, 54; Entomology 54; Science, 53
- Arabic, 34
- Aramaic (including Syriac), 34
- Archaeology, 36; Ancient Art and, 31; Classical, 27;  
History of Art and, 30
- Architectural Science, 26
- Architecture, 26
- Art, 27; American, 31; Ancient, and Archaeology, 31;  
Graphic, 27; Medieval, 31; Modern, 31; Oriental, 31;  
Renaissance and Baroque, 31
- Asian Studies, 36, 37
- Astronomy 66
- Astronomy and Space Sciences, 66
- Astrophysics, 66
- Atmospheric Science, 66
- Bacteriology, Pathogenic, 63
- Behavioral Biology, 58
- Biblical Studies, 34
- Biochemical Engineering, 66
- Biochemistry, 52; (Graduate School of Medical  
Sciences), 57; Insect, 54
- Biological Control, 54
- Biological Structure and Cell Biology, 57
- Biology, 52; (Graduate School of Medical Sciences), 57
- Biomathematics (Graduate School of Medical Sciences), 57
- Biometry, 59
- Bioorganic Chemistry, 67
- Biophysical Chemistry, 67
- Biophysics (Graduate School of Medical Sciences), 57
- Biosystematics, 52
- Botany, 52; General, 52
- Brain Functions, Theory of (Neurobiology), 58
- Business and Public Administration, 37
- Business: Policy, 37; and Public Policy, 37
- Cell Biology, and Biological Structure (Graduate School  
of Medical Sciences), 57
- Cellular Physiology, 59
- Chemical Engineering, 66; General, 66
- Chemical Microscopy, 66; Processes and Process  
Control, 66
- Chemistry, 67; Analytical, 67; Bioorganic, 67;  
Biophysical, 67; Inorganic, 67; Organic, 67; Physical, 67;  
Theoretical, 67
- Child: Development, 45; and Family Psychopathology, 45
- Chinese Literature, 27
- City and Regional Planning, 38
- Civil and Environmental Engineering, 67
- Classical: Archaeology, 27; Rhetoric in the Original  
or Translation, 27
- Classics, 27
- Cognitive Development, 45
- Collective Bargaining, Labor Law, and Labor  
Movements, 46
- Communication Arts, 39
- Community and Ecosystem Ecology, 54
- Community Service Education, 42
- Comparative and Functional Anatomy, 63
- Comparative Literature, 28
- Comparative: Physiology, 59; Politics, 44;  
Psychology, 61
- Computation, Theory of, 68
- Computer Science, 68
- Conduct, Values and, 32
- Conservation, 53; Forest, 53; Natural Resources, 53
- Consumer Economics, 40
- Consumer Economics and Housing, 40
- Creative Writing, 28
- Curriculum and Instruction, 42
- Cytology, 52; Animal 63
- Dairy: Husbandry, 51; Science, 55

## 78 Index—Fields and Subjects

- Demography-Ecology, 49  
Design, 26, 40  
Design and Environmental Analysis, 40  
Design for the Theatre, 35  
Development Sociology, 41  
Development Psychology, 61  
Differential Psychology and Psychological Tests, 61  
Drama and the Theatre, 35  
Dramatic Literature, 28
- Early Childhood Education, 45  
Early Modern European History, 30  
East Asian Linguistics, 27, 37  
Ecology, 63; Community and Ecosystem, 54; General, 54;  
Insect, 54; Marine, 54; Plant, 52; Population, 54;  
Terrestrial, 54  
Ecology and Evolutionary Biology, 53  
Econometrics and Economic Statistics, 42  
Economic: Development and Planning, 42; Entomology,  
54; Geology, 70; History, 42; and Social Statistics, 46;  
Theory, 42  
Economics, 42; Agricultural, 35, 36  
Economics of Participation and Labor-Managed  
Systems, 42  
Education, 42; Early Childhood, 45  
Educational: Administration, 42; Psychology and  
Measurement, 42; Research Methodology, 42  
Eighteenth Century, the Restoration and (English  
Language and Literature), 28  
Electric Power and Processing, 64  
Electrical Engineering, 69; Systems, 69  
Electrophysics, 69  
Embryology, 63  
Engineering: Aerospace 64; Agricultural, 64;  
Biochemical, 66; Chemical, 66; Civil and Environmental,  
67; Electrical, 69; Environmental Systems, 67; Geodetic  
and Photogrammetric, 67; Geology, 70; Geotechnical,  
68; Industrial, 73; Materials, 66; Materials and  
Metallurgical, 70; Mechanical, 71; Nuclear, 72; Nuclear  
Process, 66; Sanitary, 68; Soil and Water, 64;  
Structural, 68; Transportation, 68  
English: and American Literature, 28; History, 30;  
Linguistics, 28; Poetry, 28; Renaissance to 1660, 28  
English Language and Literature, 28  
Entomology, 54; Economic, 54; Medical, 54  
Environmental: Analysis, 40; Geology, 70; Planning and  
Design, 38; Physiology, 54; Systems Engineering, 67  
Environmental Quality, 69  
Epistemology, Metaphysics and, 32  
Ethology (Behavioral Biology), 58  
Evolutionary Biology, 54; Ecology and, 53  
Evolutionary Botany, 52  
Experimental: Physics, 74; Psychology, 61;  
Psychopathology, 61  
Extension and Continuing Education, 42
- Family: and Community Decision Making, 40;  
Relationships, 45  
Farm Management and Production Economics, 36  
Fiction, Prose, 28  
Field Crop Science, 51  
Finance, 37  
Fishery Science, 53  
Floriculture and Ornamental Horticulture, 55  
Fluid Mechanics, 75  
Food, 56; Chemistry, 55; Distribution, Marketing and, 36;  
Microbiology, 55; Science (general), 55  
Food Science and Technology, 55  
Forest Conservation, 53  
French: Linguistics, 33; Literature, 33
- Genetics, 56; Animal, 51; (Graduate School of Medical  
Sciences), 57; Plant, 59  
Geobiology, Paleontology, and Stratigraphy, 70  
Geochemistry, Mineralogy, Petrology, 70
- Geodetic and Photogrammetric Engineering, 67  
Geography, Physical, 70  
Geological Sciences, 70  
Geometry, 71  
Geomorphology, 70  
Geophysics, 70  
Geotechnical Engineering, 68  
Geotectonics and Structural Geology, 70  
German Literature, 29  
Germanic Linguistics, 29  
Germanic Studies, 29  
Government, 44  
Graphic Arts, 27  
Greek Language and Literature, 27  
Guidance and Student Personnel Administration, 42
- Hebrew, 34  
Herpetology (Vertebrate Zoology), 54  
Histology, 63  
History, 30; American, 30; Ancient, 27, 30; Early  
Modern European, 30; Economic, 42; English, 30; Latin  
American, 30; Medieval, 30, 31; Medieval Chinese, 30;  
Modern Chinese, 30; Modern European, 30; of  
Architecture, 30; of Economic Thought, 42; of  
Philosophy, 32; of Urban Development 30; of Science,  
30; Russian, 30; Southeast Asian, 30; Theatre, 35;  
Urban Planning, 38  
History and Systems of Psychology, 61  
History of Architecture and Urban Development, 30  
History of Art and Archaeology, 30  
History of Philosophy, 32  
History of Science, 30  
History, Philosophy, and Sociology of Education, 42  
Home Economics Education, 42  
Home Management, 40  
Horticulture, Floriculture and Ornamental, 55  
Hotel Administration, 45  
Hotel Accounting, 45  
Household Equipment, 40  
Housing, 40  
Human Development and Family Studies, 45  
Human Nutrition and Food, 56  
Hydraulics and Hydrology, 68  
Hydrogeology, 70
- Ichthyology (Vertebrate Zoology), 54  
Immunochemistry, 63  
Income Security, Labor Economics and, 46  
Indo-European Linguistics, 27  
Industrial and Labor Relations, 46; Problems, 46  
Industrial: Engineering, 73; Organization and Control, 42  
Information Processing (Computer Science), 68;  
(Operations Research), 73  
Inorganic Chemistry, 67  
Insect: Biochemistry, 54; Ecology, 54; Morphology, 54;  
Pathology 54; Physiology, 54; Taxonomy, 54;  
Toxicology and Insecticide Chemistry, 54  
International: and Comparative Labor Relations, 46;  
Development, 37; Economics, 42; Economics and  
Development, 36; Food Development, 55; Relations, 44  
International Agricultural Development, 47  
Invertebrate Zoology, 63  
Italian: Linguistics, 33; Literature, 33
- Labor Economics, 42; and Income Security, 46  
Landscape Architecture, 55  
Latin American History, 30  
Latin American Studies, 47  
Latin Language and Literature, 27  
Law 47  
Limnology (Aquatic Ecology), 54  
Linguistics, 48; East Asian, 27, 37; English, 28; French,  
33; General, 48; Germanic, 29; Indo-European, 27;  
Italian, 33; Romance, 33; Slavic, 34; South Asian, 37;  
Southeast Asian, 37; Spanish, 33



- Literature: American, 28; Chinese, 27; Comparative, 28; Dramatic, 28; English and American, 28; French, 33; German, 29; Greek Language and, 27; Italian, 33; Latin Language and, 27; Medieval, 31; Medieval and Renaissance Latin, 27; Russian, 34; Spanish 33  
 Logic and Philosophy of Science, 32
- Magnetohydrodynamics, 66  
 Mammalogy (Vertebrate Zoology), 54  
 Managerial Economics, 37  
 Manpower Studies, 46  
 Marine: Ecology (Aquatic Ecology), 54; Geology, 70  
 Marketing, 37; and Food Distribution, 36  
 Materials: Engineering, 66; and Metallurgical Engineering, 70; Processing 71; Science, 70  
 Materials Science and Engineering, 70  
 Mathematics, 71; Applied, 65  
 Mathematical Psychology, 61  
 Meat Science, 51  
 Mechanical Design, 71  
 Mechanical Engineering, 71  
 Mechanics: Fluid, 75; of Materials, 75; Solid, 75; Space, 75; Theoretical and Applied, 75  
 Medical Care Organization and Administration, 37  
 Medical Entomology, 54  
 Medical Sciences, Graduate School of, 57  
 Medicine, Veterinary, 63  
 Medieval: Art, 31; Chinese History, 30; History, 30, 31; Literature, 31; Philology, 31; Philosophy, 31; and Renaissance Latin Literature, 27  
 Medieval Studies, 31  
 Metallurgical Engineering, Materials and, 70  
 Metaphysics and Epistemology, 32  
 Meteorology, 51  
 Methodology of Politics, 44  
 Methods of Social Research, 41  
 Microbiology, 57; Food, 55; (Graduate School of Medical Sciences), 57; Water and Waste Water, 55  
 Mineralogy, Petrology, Geochemistry, 70  
 Modern Chinese History, 30  
 Modern European History, 30  
 Modern Art, 31  
 Monetary and Financial Economics, 42  
 Music, 31  
 Musical: Composition, 31; Performance, 31  
 Musicology, 31  
 Mycology, 60
- Natural Resources Conservation, 53  
 Neuroanatomy (Neurobiology), 58  
 Neurobiology and Behavior, 58; (Graduate School of Medical Sciences), 57  
 Neurochemistry (Neurobiology), 58  
 Neurophysiology (Neurobiology), 58  
 Nineteenth Century (English Language and Literature), 28  
 Nuclear: Engineering, 72; Process Engineering, 66; Science, 72  
 Nuclear Science and Engineering, 72  
 Numerical Analysis, 68  
 Nutrition, 58; Animal, 51; Human, 56
- Oceanography, 70; (Aquatic Ecology), 54  
 Old and Middle English, 28  
 Old Norse, 29  
 Operations Research, 73  
 Organic Chemistry, 67  
 Organization Behavior and Social Action, 41  
 Organization Theory and Behavior, 37  
 Organizational Behavior, 46  
 Oriental Art, 31  
 Ornithology (Vertebrate Zoology), 54
- Painting, 27  
 Paleobotany, 52  
 Paleocology, 54  
 Paleontology, Geobiology, and Stratigraphy, 70  
 Parasitology, 54, 63  
 Pathogenic Bacteriology, 63  
 Pathology: Insect, 54; (Graduate School of Medical Sciences), 57; Plant, 60; Veterinary, 63  
 Personality and Social Psychology, 61  
 Petrology, Geochemistry, Mineralogy, 70  
 Pharmacology, (Graduate School of Medical Sciences), 57; Veterinary, 63  
 Philology: Medieval, 31; Romance, 33  
 Philosophy, 32; Ancient, 27; History of, 32; History, and Sociology of Education, 42; and Logic of Science, 32; Medieval, 31  
 Phycology, 52  
 Physical Anthropology, 36  
 Physical Biology, 59, 63  
 Physical Chemistry, 67  
 Physical Geography, 70  
 Physics, 74; Applied, 65; Experimental, 74; Theoretical, 74  
 Physiological Psychology, 61  
 Physiology, 59; Animal, 63; Cellular, 59; Comparative, 59; Environmental, 54; (Graduate School of Medical Sciences), 57; Insect, 54; Plant, 52; Sensory (Neurobiology), 58; Vertebrate, 59  
 Physiology of Reproduction, 51  
 Planetary Studies, 66  
 Planning Theory and Systems Analysis, 38  
 Plant: Breeding 59; Ecology, 52; Genetics, 59; Morphology and Anatomy, 52; Pathology, 60; Physiology, 52; Taxonomy, 52  
 Plant Breeding and Biometry, 59  
 Plant Pathology, 60  
 Playwriting, 35  
 Pleistocene Geology, 70  
 Poetry, English, 28  
 Policy and Prices, 36  
 Political Thought, 44  
 Politics: American, 44; Comparative, 44; Methodology of, 44  
 Pomology, 60  
 Population Ecology, 54  
 Poultry Science, 51  
 Power and Machinery, 64  
 Preservation Planning, 30  
 Production and Operations Management, 37  
 Prose Fiction, 28  
 Psychological Tests, Differential Psychology and, 61  
 Psycholinguistics, 61  
 Psychology, 61; Comparative, 61; Developmental, 61; Differential, and Psychological Tests, 61; Experimental, 61; General 61; History and Systems of, 61; Industrial, 61; Mathematical, 61; Personality and Social, 61; Physiological, 61  
 Psychopathology, Experimental, 61  
 Public Administration, 37; and Finance, 36; Business and, 37  
 Public Finance and Fiscal Policy, 42  
 Public Policy, 48
- Quantitative Analysis for Administration, 37
- Radiation Biology (Physical Biology), 63  
 Radiophysics, 66  
 Regional Economics and Development Planning, 38  
 Regional Science, 38, 48, 49  
 Renaissance and Baroque Art, 31  
 Research Methodology, 49  
 Resource Economics, 36  
 Restoration and Eighteenth Century (English Language and Literature), 28  
 Romance: Linguistics, 33; Philology, 33  
 Romance Studies, 33

## 80 Index—Fields and Subjects

- Rural Sociology, 41  
Russian: History, 30; Literature, 34
- Sanitary Engineering, 68  
Science and Environmental Education, 42  
Sculpture, 27  
Sedimentation, 70  
Seed Technology, 51  
Seismology, 70  
Semitic Studies, 34  
Sensory Physiology (Neurobiology), 58  
Slavic Linguistics, 34  
Slavic Studies, 34  
Social Anthropology, 36  
Social and Health Systems Planning, 38  
Social and Personality Development, 45  
Social Organization and Change, 49  
Social Psychology, 49  
Social Research, Methods of, 41  
Social Statistics, Economic and, 46  
Sociolinguistics, 48  
Sociology, 49; of Development, 41; General, 49; History, Philosophy, and, of Education, 42; of Development, 41; Rural, 41  
Soil Science, 51  
Soil and Water Engineering, 64  
Solid Mechanics, 75  
South Asian Linguistics, 37  
Southeast Asian: History, 30; Linguistics, 37  
Space Mechanics, 75  
Space Sciences (General), 66  
Spanish: Linguistics, 33; Literature, 33  
Statistics, 50; Econometrics and Economic, 42; Economic and Social, 46  
Stratigraphy, Geobiology, Paleontology and, 70  
Structural Engineering, 68  
Structural Geology, Geotectonics and, 70  
Structural Mechanics, 68
- Student Personnel Administration, Guidance and, 42  
Systems Analysis and Design, 73
- Taxonomy: Insect, 54; Plant, 52  
Terrestrial Ecology, 54  
Textiles and Clothing, 40  
Theatre Arts, 35  
Theatre: History, 35; Theory and Aesthetics, 35  
Theoretical and Applied Mechanics, 75  
Theoretical Physics, 74  
Theory of Brain Functions (Neurobiology), 58  
Theory of Computation, 68  
Theory of Music, 31  
Thermal: Power, 71; Processes, 71  
Toxicology and Insecticide Chemistry, 54  
Transportation Economics and Policy, 37  
Transportation Engineering, 68  
Twentieth Century (English Language and Literature), 28
- Urban: Design, 26; Planning History, 38; and Regional Theory, 38  
Urban Studies, 50
- Values and Conduct, 32  
Vegetable Crops, 62  
Vertebrate: Physiology, 59; Zoology, 54  
Veterinary: Anatomy, 63; Obstetrics and Diseases of the Reproductive Organs, 63; Pathology, 63; Pharmacology, 63; Surgery, 63; Virology, 63  
Veterinary Medicine, 63
- Water Resources Systems, 68  
Water Resources, 75  
Water and Waste Water Microbiology, 55  
Wildlife Science, 53
- Zoology: 63; Invertebrate, 63; Vertebrate, 54

# General Index

- Activities for graduate students, 14  
Admission to candidacy examination, 13  
Admission: applications for, 8; categories of, 8;  
    requirements for, 7. *See also* individual Fields of instruction  
Advanced degrees offered, 8, 15  
Africana Studies and Research Center, 21  
Agricultural Experiment Station (Geneva, N.Y.), 25  
American Studies, 22  
Application: fee, 8; for admission, 8; for fellowships, 10  
Assistantship: research, 10; residence hall, 11;  
    teaching, 10  
Brookhaven National Laboratory, 22  
Calendar, 4  
Candidates for Degree Only, 9  
Career, Summer Plans, and Placement Center, 15  
Center for Environmental Quality Management, 22  
Center for Improvement of Undergraduate Education, 22  
Center for International Studies, 19  
Center for Radiophysics and Space Research, 23  
Center for Urban Development Research, 22  
Center for Water Resources and Marine Sciences, 24  
Change of Status, 8  
China Program, 19  
Clinic, 14  
Cornell-Sydney University Astronomy Center 23  
Counseling service, 15  
Courses and grades, 14  
Degree programs, 8, 15  
Degree requirements, 11. *See also* individual Fields of instruction  
Development Studies, 23  
Division of Biological Sciences, 23  
Educational Testing Service, 8  
Employment: effect on fellowships, 10; effect on  
    residence credit, 13; opportunities for part-time, 11;  
    opportunities for spouses of students, 11. *See also*  
    research and teaching assistantships  
English proficiency, 8  
European Studies Committee, 19  
Examinations: admission to candidacy 13; final (master's  
    degree) 13; final (thesis) (Ph.D. degree), 13; Graduate  
    Record, 8; qualifying, 13. *See also* individual Fields of  
    instruction  
Extramural study, 13. *See also* *Employment*  
Fees: application, 8; Candidate for Degree Only, 9; in  
    absentia, 10; Registration Deposit, 9; Summer Session,  
    9; Summer Research, 9; thesis, 9. *See also* Tuition  
Fellowships: application for, 10; notification date of, 11.  
    *See also* individual Fields of instruction  
Field representatives, 8  
Fields of instruction, 26. *See also* the Index of Fields of  
    Instruction and Major and Minor Subjects  
Final examinations, 13  
Financial support, 10  
Foreign language requirement, 13  
Foreign students, 15  
Gannett Medical Clinic, 14  
General information, 14  
Grades and courses, 14  
Graduate Center, 14  
Graduate Record Examinations, 8. *See also* individual  
    Fields of instruction  
Graduate School of Medical Sciences, 17  
Graduate work taken elsewhere, 12  
Health: requirements 14; services, 14  
Insurance, medical, 14  
International Agriculture Program, 19  
International Legal Studies Program, 19  
International Population Program, 20  
International Science and Technology, 20  
International Student Office, 15  
International Studies Program, 18  
Laboratory for Plasma Studies, 24  
Languages: instruction in, 13; requirements, 13  
Latin American Studies Program, 20  
Libraries, 18  
Living arrangements, 14  
Loans, 11  
Materials Science Center, 23  
Military Science and Aerospace Studies, 25  
Minority group fellowships, 11  
Motor vehicles, 14  
National Defense Education Act Fellowships, 11  
National Science Foundation Fellowships, 11  
Noncandidates, 8  
Office of Computer Services, 25

## 82 General Index

- Part-time studies, 13. *See also* Employment  
Peace Studies Program, 20  
Placement Center, Career, Summer Plans and, 15  
Prizes, 11  
Program on Participation and Labor-Managed Systems, 20  
Program on Science, Technology, and Society, 24  
Professional degrees, 15  
Prorating of tuition, 9  
Professors-at-Large, 76  
Provisional candidates, 8
- Qualifying examination, 13
- Refund of tuition, 9  
Research assistantships, 10  
Residence credit, 12; eligibility for, as affected by employment, 13; transfer of, 12  
Residence hall assistantships, 11  
Resources for research and advanced study, 18  
Rural Development, 21
- Scholar Incentive Payments, 11
- Society for the Humanities, 24  
South Asia Program, 21  
Southeast Asia Program, 21  
Soviet Studies, 21  
Special Committee, 11; Chairman of, 12  
Special facilities and service organizations, 25  
Statistics Center, 24  
Summer Research, 13; tuition and fees for, 9  
Summer Session, 12; tuition and fees for, 9
- Teaching Assistantships, 10  
Test of English as a Foreign Language, 8  
Thesis, 13; fee, 9  
Transfer of residence credit, 12  
Tuition, 9; prorating of, 9; refund of, 9; Summer Session, 9; Summer Research, 9. *See also* Fees
- University Libraries, 18; Archives, 18; special collections, 18  
University Press, 25
- Visual aids, 25



## List of Announcements

Following is a list of *Announcements* published by Cornell University to provide information on programs, faculty, facilities, curricula, and courses of the various academic units.

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