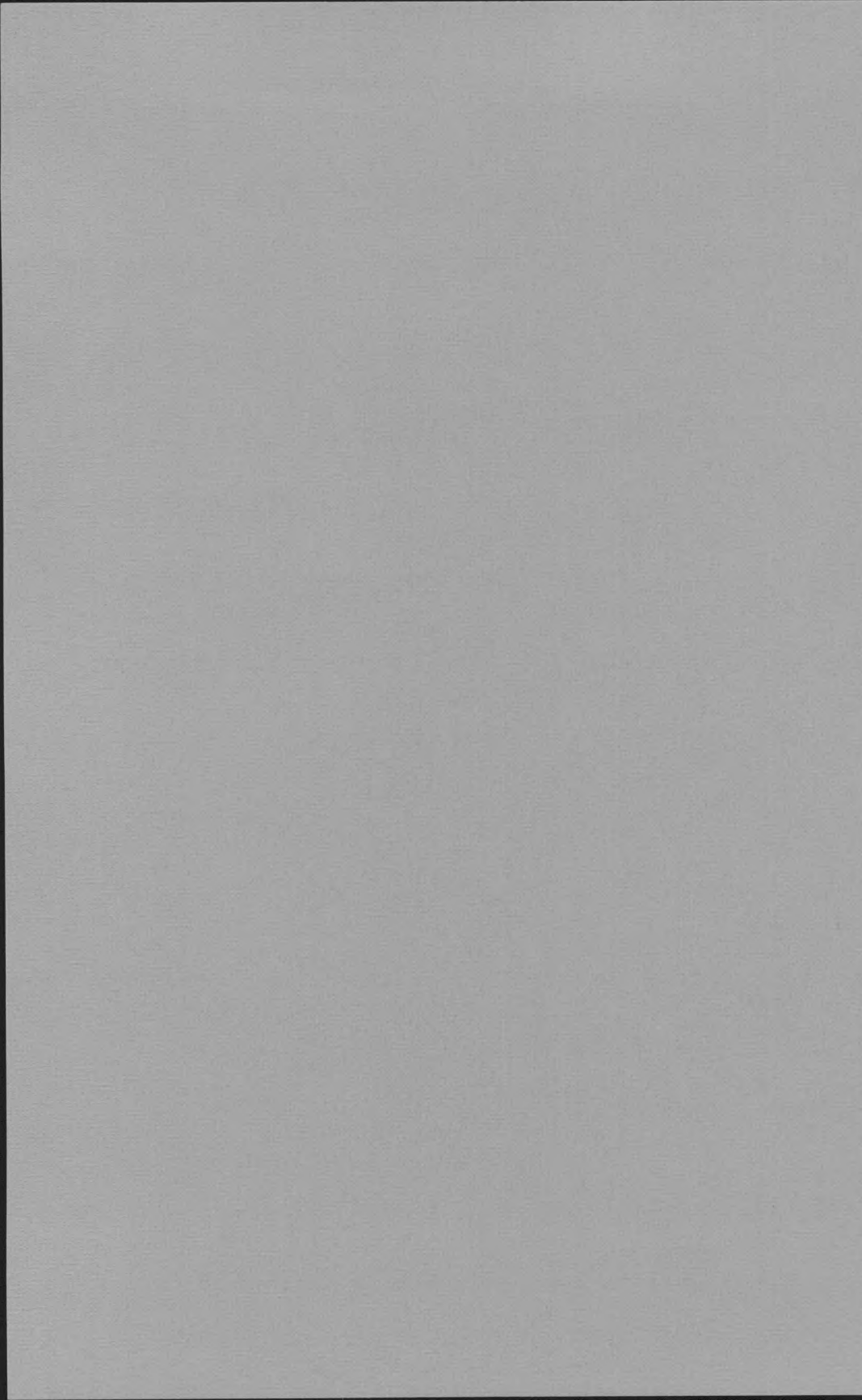




**Graduate  
School**



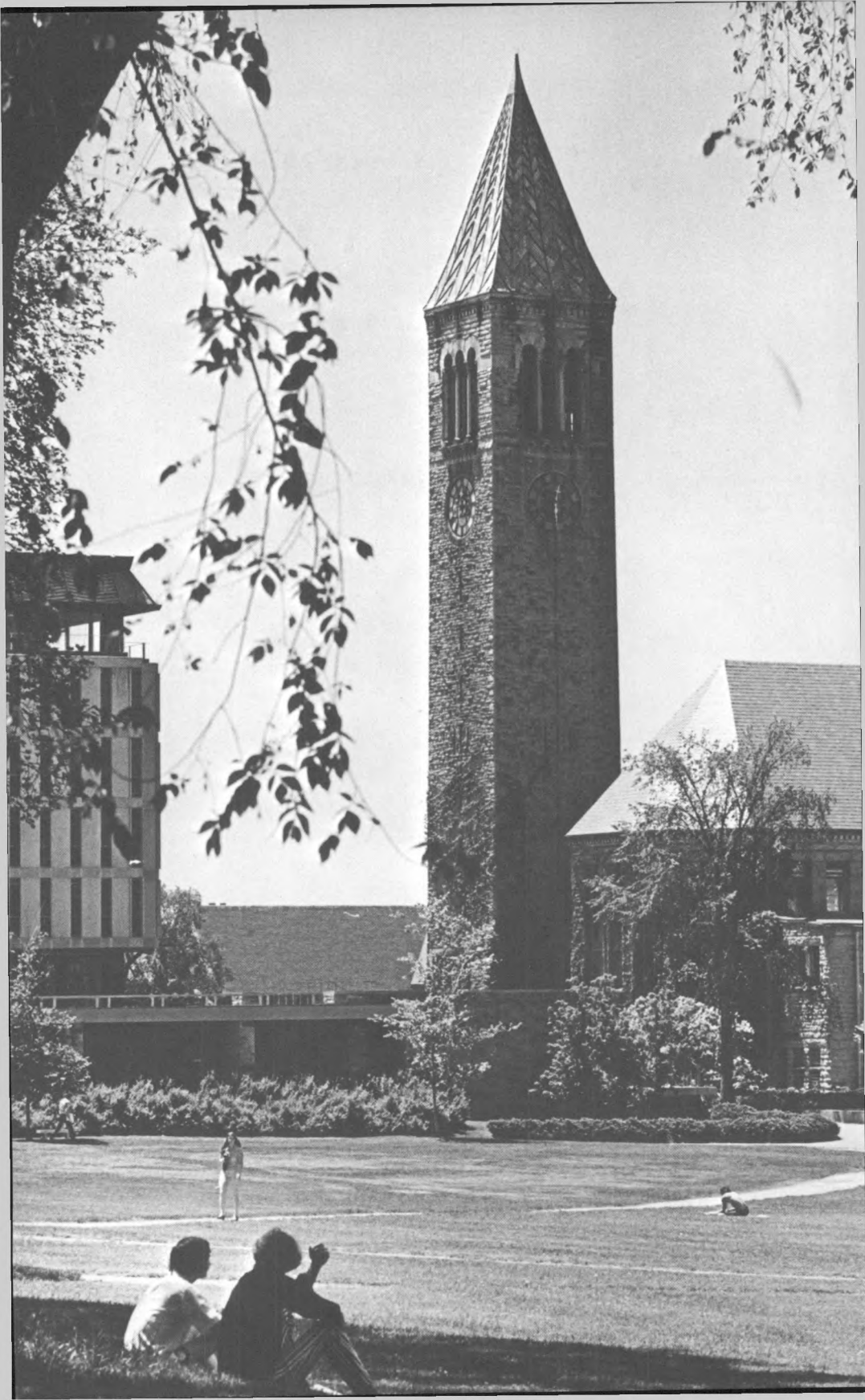
**Cornell University**

**Graduate School**

**1975-76**

**Cornell University Announcements**

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## Announcements

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1975-76

## Graduate School Calendar

### *Fall Term*

Registration, new students

Registration, continuing and rejoining students

Fall term instruction begins

Last day for filing statement-of-courses forms, change-of-committee forms, and nomination-of-committee forms

Last day for students to take admission-to-candidacy examinations in order to have them considered by the beginning of the term

Last day for change of course registration

Instruction suspended for Thanksgiving recess  
1:10 p.m.

Instruction resumed

Fall term instruction ends, 1:10 p.m.

Final examinations begin

Final examinations end

Last day for completing all requirements for a January degree

### *Spring Term*

Registration, new and rejoining students

Registration, continuing students

Spring term instruction begins

Last day for filing fellowship and scholarship applications for 1976-77

Last day for filing statement-of-courses forms, change-of-committee forms, and nomination-of-committee forms

Last day for students to take admission-to-candidacy examinations in order to have them considered by the beginning of the term

Instruction suspended for spring recess,  
1:10 p.m.

Instruction resumed

Last day for completing all requirements for a May degree

Final examinations begin

Final examinations end

Commencement Day

Thursday, August 28

Friday, August 29

Monday, September 1

Wednesday, September 10

Wednesday, October 1

Friday, November 7

Wednesday, November 26

Monday, December 1

Saturday, December 6

Saturday, December 13

Saturday, December 20

Friday, January 9

Thursday, January 22

Friday, January 23

Monday, January 26

Friday, January 30

Wednesday, February 4

Monday, March 1

Saturday, March 27

Monday, April 5

Friday, May 14

Monday, May 17

Monday, May 24

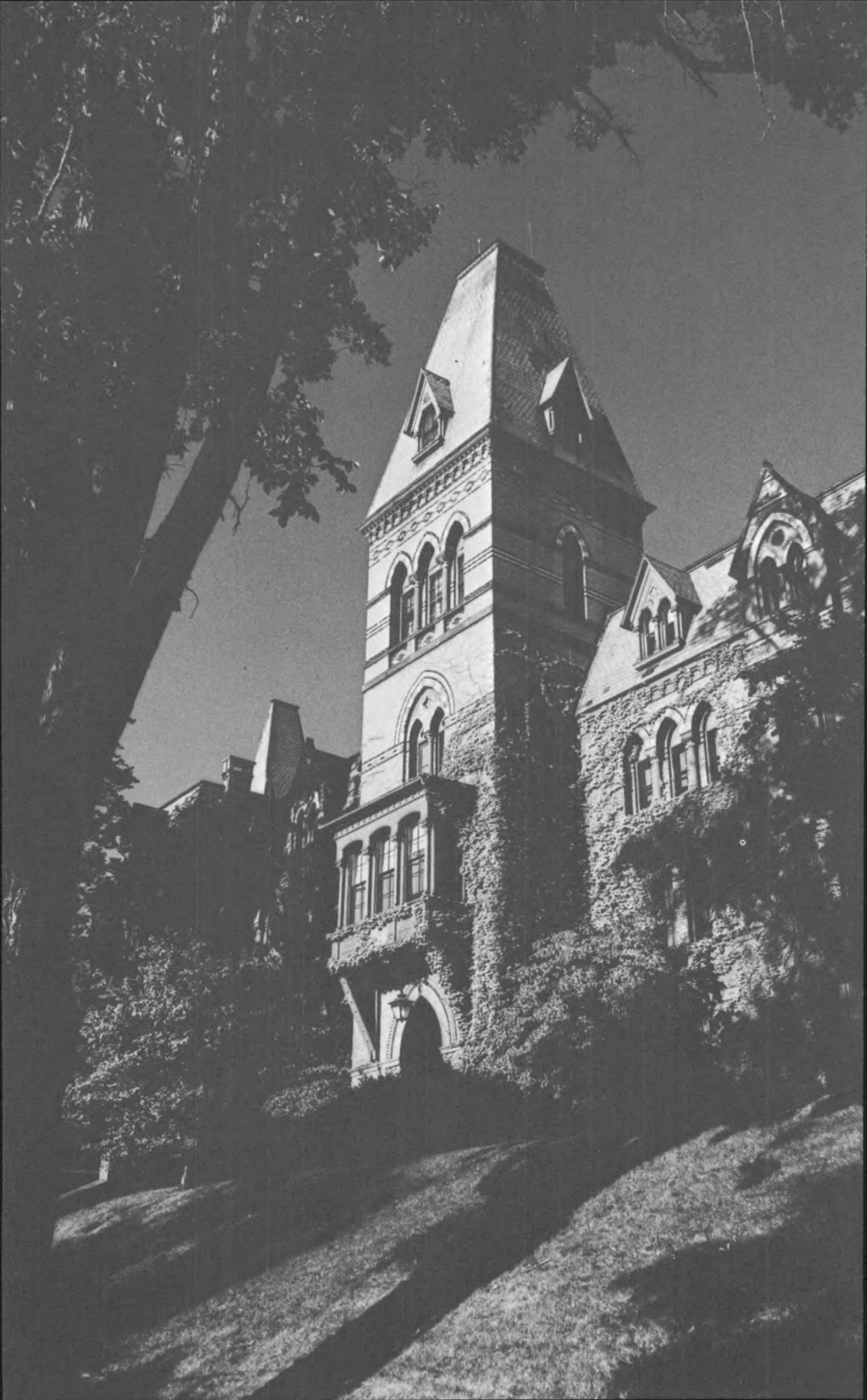
Friday, May 28

*Summer*

Summer Research period begins	Monday, May 24
Registration for Summer Session	Wednesday, June 23
Last day for filing statement-of-courses forms, change-of-committee forms, and nomination- of-committee forms	Wednesday, June 30
Summer Session ends	Friday, August 6
Last day for completing all requirements for an August degree	Friday, August 20
Summer Research period ends	Thursday, August 26

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.



## 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 and women after whom such standards are themselves fashioned.

Cornell graduate students select not only the studies they wish to pursue, but also the

scholars under whose tutelage they wish to pursue the studies. The candidate, 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 and the associate or minor members, 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 selected by the student to direct the graduate program. 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 the 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 the degree whenever the Special Committee judges the student 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 the dean's 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 equality of educational opportunity. No student shall be denied admission to the University or be discriminated against otherwise because of race, color, creed, religion, national origin, or sex.

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. As some fields will not accept new students for the spring term, applicants should check with the graduate faculty 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 the 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 in those fields which require the GRE. 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. 16-19. 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 14853. 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 Fields of Instruction listings, p. 29 ff, should be

## 9 Tuition and Fees

consulted for fields requiring the scores of both the Aptitude Test and the pertinent Advanced Test.

For students applying from institutions with S-U grading systems, particularly S-U grading in major and related subjects, submission of scores from the Graduate Record Examinations including the Advanced Test in the student's area of specialization is strongly encouraged. Without such scores many students' applications would contain little useful information on which to judge their admissibility.

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. Failure to pay tuition to the University at the Bursar's Office within the prescribed period of grace will terminate registration in the University unless an extension of time to complete payment has been granted by the bursar. Such an extension is permitted when, in the judgment of the bursar, the circumstances of a particular case warrant 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 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, unless previously matriculated as a student at Cornell University, must make a deposit of \$50 after receiving notice of acceptance. This deposit is used at the time of first registration to pay the \$50 Registration Fee. The deposit will not be refunded to any candidate whose application is withdrawn after May 10 or more than twenty days after 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 generally \$1,715 each term for all students registered in the Graduate School. Exceptions are the following: those with major work in the Field of Education and the Division of Biological Sciences, and those enrolled in a Master of Arts in Teaching program are all charged \$850 a term. Those whose major chairperson is on the faculty of the statutory divisions of Agriculture and Life Sciences, Human Ecology, and Industrial and Labor Relations are also charged \$850 a term. Those whose major professor is on the faculty of the statutory division of Veterinary Medicine are charged \$1,050 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 a summer session or is not doing productive work for the department.

Any student who is to receive less than full residence credit because of employment should apply for proration of tuition on forms procurable at the Graduate School Office. Tuition is based on residence eligibility (see p. 14).

A special tuition rate of \$400 a term has been established for students who have satisfactorily completed four or more years of study at Cornell in the same Ph.D. program, who have no support or other financial aid from the University, who have passed their Admission to Candidacy Examination, and who are not taking courses or making use of classroom or laboratory facilities.

## Fees

**Candidate for Degree Only.** A graduate student who returns to the University to present a 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 the approved thesis and abstract in final form are deposited. 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 subsequent academic term, if they are obtaining residence credit, but not otherwise.

**In Absentia.** A graduate student registered in absentia pays a fee of \$75 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 on the application for admission form the type or*

*types of financial aid for which consideration is wished.*

Extensive financial resources are available to help Cornell graduate students with educational costs. Currently, approximately 2,060 of the 3,500 graduate students receive financial aid in the form of fellowships, teaching assistantships, and research assistantships. However, with sharply contracting outside support, the number of students with fellowships or assistantships is expected to decrease.

In most cases the stipends awarded to graduate students are not sufficient to cover living expenses completely, and other sources of supplementary income, such as loans, may be necessary. Much depends on the standard of living the individual is accustomed to. Experience has shown that married students with dependent children have particular financial difficulties. The minimum subsistence income needed by married students is about \$5,000 plus tuition each academic year.

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

## Assistantships and Fellowships

### 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 one that is closely related. The duties require up to twenty total clock hours of the student's time a week, depending on the field. A teaching assistant whose duties are in the major field of interest and do not exceed twenty hours is eligible for full residence credit. 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 the department chairperson. Applications for these positions should be made to the graduate faculty 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 Special Committee chairperson. The student is required to spend twenty hours a week, but full-time residence credit can be earned if the research is in the field of major interest. 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 usually provides tuition and a substantial stipend for living expenses. Students holding fellowships are free to select their own research projects, subject to approval of their Special Committees, and their primary responsibilities are to study for their 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 each 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. This program has an early November deadline. 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 a fellowship has been awarded. 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 granting admission.

### Residence Hall Assistantships

Approximately twenty-five resident hall assistantships are available for single or married graduate students in any academic field who wish to apply for a head resident position in undergraduate or graduate residence halls. 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. Applicants must participate in a lengthy selection process on campus, so positions are generally available to second-year graduate students only. A personal interview is required of all applicants. Details about assistantships and application forms may be obtained from the Office of the Dean of Students, Barnes Hall.

## Other Support

### 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.

### Tuition Assistance Program

Students who are legal residents of New York State may be eligible for the Tuition Assistance Program; 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 Direct Student Loan Program and for University loans are available at the Office of Scholarships and Financial Aid, 203 Day Hall; the application date is the mid-April prior to the student's fall matriculation. Increasingly the University is referring both undergraduate and graduate students to their state loan programs. 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 Student Employment Office, Day Hall. Candidates may find of value employment in research or other work closely allied to their academic interests; on the other hand, progress in candidacy is difficult when students attempt to support themselves wholly or partially by work unrelated to their studies.

### Employment for Spouses of Students

Cornell University offers a variety of non-academic positions for working spouses through the Personnel Department, B-12, Ives Hall.

In addition, the Ithaca area offers opportunities for positions in small industrial plants, at Ithaca College, in the local hospital, and with 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. However, grades of C+ through D-, while passing, do not normally constitute satisfactory progress for a student enrolled in the Graduate School. The same holds for Incompletes.

The student's program is developed with the aid and direction of a Special Committee which is composed of members of the graduate faculty chosen by the student and is designed to fit the student's 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 whose supervision a Master of Arts or a Master of Science candidate carries on work is composed of a chairperson, who represents the major subject, and one representative of an appropriate minor subject. The Special Committee of a doctoral student is composed of a chairperson, representing the major subject, and two other members representing other areas of interest. The chairperson of the Special Committee directs the student's thesis research. Some fields require two minor subjects for doctoral programs while others require only one. All Ph.D. Special Committees have three members.

The student is admitted to a specific field, and in deciding upon a program of study may select a major subject from among those listed in this *Announcement* under the field of interest. It is the student's privilege to ask any member of the graduate faculty belonging to this field to serve as chairperson and represent the major subject. The chairperson, in turn, advises the student about minor subjects and faculty members who might represent them on the student's Special Committee. It is the privilege of the faculty member to decline to serve on a student's Special Committee. A change in Special Committee after four units of residence requires the approval of the dean of the Graduate School.

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

## 13 Degree Requirements

Committee must be recorded in the Graduate School Office within two weeks of the beginning of residency. Since students may be uncertain of their aspirations at that time, they are encouraged to change the membership of their Special Committee as their 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 graduate faculty representative or other faculty member may serve temporarily as the chairperson while the student seeks a permanent chairperson and committee. The members of the Special Committee direct the student's program and decide whether satisfactory progress toward the degree is being made. 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 persons working off campus may become proficient in a technique or even in a field of knowledge, they 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, they need persistent and continuing interaction with others engaged in similar pursuits. They should form the habit of attending lectures, seminars, and meetings of groups in whose activities they take 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. 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 the residence. A candidate for the doctorate may be permitted to count study for the master's degree, if it is relevant to the 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 the Special Committee has had opportunity to judge the student's 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 a summer session, the candidate must register in both 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 the 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, and substantial funds are available for support. Students registered for Summer Research on a noncredit basis have access to the regular services of the University clinic and infirmary during the summer without charge if they have been registered as full-time students during the previous academic term. Under certain conditions, students may accumulate residence credit.

### Part-Time Studies

Essentially, all graduate students at Cornell are full-time students. If employment is neces-

## 14 General Information

sary, students may hold positions requiring up to ten hours of work each 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 Each Semester			
Total clock hours each week	Contributory in major field; on campus	Noncon-tributory; 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 each week off campus, or more than thirty clock hours each week under any circumstances, may earn a maximum of two-fifths of a residence unit a 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, 105 Day Hall.

Information about a part-time master's program for established Ithaca residents may be obtained from the Graduate School office.

### 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. The examination must be scheduled at least seven days in advance in the Graduate School office. 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 a 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

All academic courses of the University are open to students of all races, religions, ethnic origins, ages, sexes, and political persuasions. No requirement, prerequisite, device, rule, or other means shall be used by any employee of the University to encourage, establish, or maintain segregation on the basis of race,

## 15 General Information

religion, ethnic origin, age, sex, or political persuasion in any academic course of the University.

### 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. Grades of C+ through D-, while passing, do not normally constitute satisfactory progress for a student enrolled in the Graduate School. The same holds for Incompletes.

### 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. A booklet which details off-campus housing in the Ithaca area is available upon written request to the Housing Services Office.

### 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 with or without an appointment. Students are also entitled to routine laboratory and X-ray examinations indicated for diagnosis and treatment, medical care in the Sage Infirmary for a maximum of fourteen days each term, and emergency 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, the cost must be borne personally.

In order to protect the student while on vacation or for hospitalization in Ithaca, Cornell has a mandatory health insurance plan to supplement the services outlined above. (This plan may be waived if the student has other health insurance.) Information about this insurance may be obtained at the Gannett Clinic from the insurance company representative. Further, there is a prepaid plan for spouses of regularly enrolled students. Additional information may be obtained at Gannett Clinic.

A student may be required to withdraw from Cornell if, in the opinion of the University authorities, health problems make further attendance unwise.

### Motor Vehicles

The University requires that *all* members of the campus community register with the Traffic Bureau at 203 Rand Hall any vehicles (including cars, trucks, motorcycles, and motor-scooters) in their possession which are at *any time* parked on the Ithaca campus.

A fairly complete listing of all parking and traffic regulations is to be found in the pamphlet, *Cornell University Regulations Governing Motor Vehicles*, available at the time a vehicle is registered.

The Traffic Bureau will be glad to assist with general inquiries, special problems, and requests. Correspondence should be directed to: Traffic Bureau, 203 Rand Hall, Cornell University, Ithaca, N. Y. 14853, telephone 607/256-4600.

### 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.

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.

Ithaca families participate in a Host Family Program where foreign students are invited to share in some aspects of American family life in the community. 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 Career Center**

The Career Center at 14 East Avenue (in Sage Hall) is a resource and information center for jobs in business, industry, government, and teaching. Information is also available for graduate programs leading to the professions, for 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 free *Newsletter*. The center also provides an alumni placement service.

## **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.

\* 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 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

## 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 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. Graduate students interested in the M.P.S. (Agr.) degree may select from among the following fields: agricultural economics, education, agricultural engineering, agronomy, animal science, entomology, floriculture and ornamental horticulture, food science, international agricultural and rural development, natural resources, plant breeding, plant pathology, pomology, poultry science, rural sociology, vegetable crops. Detailed information may be obtained from Director Herbert L. Everett, 192 Roberts Hall.

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

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

**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.

**Master of Landscape Architecture [M.L.A.].** Professional training in the areas of land plan-

ning and design. Individuals with an undergraduate degree in design (including architecture), landscape architecture, city planning, and environmental design may be admitted as candidates.

## 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 is designed for and limited to those preparing for teaching the following subjects only in secondary schools: agriculture, biology, chemistry, earth science, English, French, German, home economics, mathematics, physics, Russian, and Spanish. The student and the Special Committee will select those courses and seminars in the teaching specialty and in education which are deemed most appropriate for developing competence as a teacher. The student will be required to demonstrate 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 not eligible for this degree.

**Doctor of Education [Ed.D.].** The program for this degree is designed to prepare candidates 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. A minimum of sixty-five credit hours beyond the bachelor's degree is required, of which thirty-five 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 the 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 (Aerospace), Master of Engineering (Agricultural), Master of Engineering (Chemical), Master of Engineering (Civil), Master of Engineering (Electrical), Master of Engineering (Engineering Mechanics), Master of Engineering (Engineering Physics), Master of Engineering (Industrial), Master of Engineering (Materials), Master of Engineering (Mechanical), Master of Engineering (Nuclear).

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.

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.

## Hotel

**Master of Professional Studies (Hotel Administration) [M.P.S.(H.Ad.)].** This degree is available to students who already possess a bachelor's degree in an area other than hotel administration. It also allows students with a B.S. in hotel administration to continue on a more professionally oriented and less research inclined level than the Master of Science. The mode and curriculum for completing this program vary according to areas previously studied. For further information see pp. 8 and 55 or write to the Graduate Faculty Representative, School of Hotel Administration, Statler Hall.

## Human Ecology

**Master of Professional Studies (Human Ecology) [M.P.S.(Hu.Ec.)].** This degree is intended for practicing professionals in human ecology-related areas who want further study in a subject or problem area pertinent to their profession, but who are not necessarily interested in a research degree. Applicants may apply for the M.P.S.(Hu.Ec.) degree in any of five fields associated with human ecology—consumer economics and housing, design and environmental analysis, education, human development and family studies, and nutrition—or for an interdepartmental program of studies in human ecology. Degree requirements include a minimum of two residence units (one of which must be earned during the academic year), completion of thirty credit hours including a problem-solving project, and a final oral examination. Detailed information may be obtained from the Office of Graduate Education, N-116 Martha Van Rensselaer 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 Faculty Representative, School of Industrial and Labor Relations, Ives Hall.

## International Development

**Master of Professional Studies (International Development) [M.P.S.(I.D.)].** This degree program provides an interdisciplinary course of study for experienced practitioners in international development who seek to upgrade their educational qualifications in areas of specific relevance to their professional careers. The course of study consists of at least thirty hours of credit, including an applied research project. Ordinarily, students will divide their course work between methods of analysis such as development administration and planning, development economics, development politics, development sociology, or international communication and one of the following substantive concentrations: nutrition, regional planning, and population. Further information is found on page 58 of this *Announcement*, and a descriptive brochure may also be obtained from the Center for International Studies, 170 Uris 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 students who desire to increase their 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

**Master of Fine Arts [M.F.A.], Doctor of Musical Arts [D.M.A.].** 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. 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.

## 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 admin-

istered 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 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. 71).

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.

Teaching fellowships and research assistantships are available. Information on other 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 four million and that figure increases by about 150,000 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. During the term, Olin Library is open until midnight on Sunday through Thursday and until 10:00 p.m. Friday and Saturday nights.

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 Department of Manuscripts and Archives is a repository with total holdings of more than 21,000,000 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 collec-

tions 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, 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.

**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 providing a continuing source of innovation and experimentation in international studies. Through its constituent programs it 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 each 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.

A program of grants (up to \$500 for graduate students and up to \$2500 for faculty) for research of international or comparative significance, awarded competitively in the fall semester, is sponsored by the Center. Further information may be obtained from the Center for International Studies, 170 Uris Hall.

**The China-Japan 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 and Japanese languages sufficient to permit use of Chinese and Japanese sources in courses and seminars and in research is expected. NDFL Title VI fellowships are available to some students in the program.

The focus of much of the research and teaching in the program is the history, society, economy, and culture of traditional and contemporary China and Japan. Research supported by the China-Japan Program includes: Chinese and Japanese economic development; center-regional relationships in traditional and modern China; Japanese and Chinese linguistics; Southern Chinese and Sino-Tibetan dialects; contemporary Chinese and Japanese 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-Japan Program, 140 Uris Hall.

**The International Agriculture Program** 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 and Rural Development. Students may take courses which help them apply their knowledge to the special conditions of newly developing nations, consult with experienced faculty members in regard to such applications, and pursue dissertation research projects 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 the Director, International Agriculture Program, 102 Roberts Hall.

**The International Legal Studies Program** offers 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.

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. Barceló, Chairperson, Graduate Study Committee, Cornell Law School.

**The International Population Program**, at the graduate level, 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. Population is one of the four concentrations available for the Master of Professional Studies (International Development) [M.P.S.(I.D.)] degree. Further information may be obtained from the International Population Program, Room 370, Uris Hall.

#### **The Program on Policies for Science and Technology**

sponsors multidisciplinary teaching and research related to the use of science and technology policy by developing countries in pursuit of their development goals. Emphasis is placed on how these countries can build indigenous capabilities to make informed choices from among existing technologies, to adapt them to domestic conditions, and to foster innovation in order to become less dependent on external sources of technology. Research themes include agricultural production (particularly food processing), industrial production, regional development planning (particularly low-cost housing policy and transportation), education (particularly engineering at the university level), and natural resource management (particularly water). Issues of policy study which cut across these themes include national development objectives, characteristics of alternative technologies, sources of technology supply, nature of technology demand, linkages between supply and demand, and the institutional infrastructure for designing and implementing national science and technology policy.

A graduate minor in this area may be obtained by utilizing the interdisciplinary minor field, Public Policy, which includes a science and technology policy "stream" within it. No formal graduate major is available, but several academic fields have one or more faculty members participating in the program. Thus, Ph.D. candidates, working with their Special Committees can focus their studies in this area. The program maintains a modest research library, and provides support for both faculty and student research projects.

Further information may be obtained from the Program on Policies for Science and Technology in Developing Nations, Room 180, Uris Hall.

**The Latin American Studies Program.** Resources in Latin American Studies include formal course work, ample library facilities, and widely based research networks developed by the faculty. There is diversity, for some aspect of virtually every Latin American country has been examined by at least one member of the program. Research tends to be problem-oriented, with relevant data applied 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.

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

In addition to these specific geographical concentrations, research is underway on problems generally characteristic of developing nations: the processes and consequences of rapid agricultural development, urbanization, population problems, and the presence of the United States in Latin America.

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 for dissertation field research from 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 research activities.

Additional information may be obtained by writing to Tom E. Davis, Director, Latin American Studies Program, 190 Uris Hall.

#### **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.

**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. Graduate students can participate by choosing one or more faculty members associated with the Peace Studies Program to serve on their Special Committee.

## 23 Special Resources

Further information may be obtained from the director, Professor Lawrence Scheinman, Center for International Studies, 170 Uris Hall.

**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 chairperson, Professor Norman Uphoff, Center for International Studies, 170 Uris Hall.

**The South Asia Program** encompasses the study of Bhutan, Sri Lanka (Ceylon), India, Nepal, and Pakistan. Qualified graduate students interested in specializing in the study of South Asia can minor in the Field of Asian Studies, in South Asian linguistics, or in Oriental art (South Asian Art History). The doctoral candidate should 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, Sri Lanka, 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, research projects on the palaeo-anthropology of the subcontinent of India and Sri Lanka, and 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 Sinhala language and linguistic problems of Sri Lanka, 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 ongoing 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.

Additional information about the South Asia Program may be obtained by writing to the Director, South Asia Program, 130A Uris Hall.

**The Southeast Asia Program** offers substantial facilities for graduate study and research and provides exceptional opportunities for the study of all of Southeast Asia in various disciplines of the humanities, social sciences, and some natural sciences. Apart from the specialized major fields of Southeast Asian history and Southeast Asian art history, there is no major field in Southeast Asian studies as such, and graduate students may major in a discipline and minor in Asian Studies/Southeast Asia, Southeast Asian linguistics, Southeast Asian history, or Southeast Asian art history. Instruction in the major languages of the region is an integral part of the graduate training of the program, which is also strengthened by exceptional library resources, regular interdisciplinary courses on the countries of the region, and an extensive program of informal seminars and visiting lecturers.

Possible sources of financial aid include Southeast Asia Program Fellowships; National Defense Foreign Language (NDEA Title VI) Fellowships; and, for advanced Ph.D. candidates, Fulbright-Hays funded Doctoral Dissertation Research Fellowships. Information about Foreign Area Training Fellowships may be obtained by writing to the Social Science Research Council, 605 Third Avenue, New York, New York 10016.

Additional information on the program and the various fellowships and awards may be obtained by writing to the Director, Southeast Asia Program, 120 Uris Hall.

**Soviet Studies.** The University offers many 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 within a wider 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 Walter Pintner, Chairperson, Committee on Soviet Studies, Uris Hall.

**The Western Societies Program**, with Europe as its substantive core but with interests in other advanced societies, gives primary emphasis to historical and contemporary developmental problems of the West. Among the program's concerns are: the problem of cultural identities and center-periphery tensions in modern Europe; the changing social cleavages and patterns of conflict between labor and management in advanced societies; the crises of economic and policy planning in the face of recent changes in social and political participation; and the problem of the control and use of technological resources in the contemporary western economy. The program's members are also interested in the impact on western societies of the growing interdependence of the international system: economic, political, and strategic.

The Western Societies Program includes faculty from the social sciences, history, industrial relations, public policy, and urban and regional planning, and is administered by an Executive Committee drawn from these departments. The program provides moderate research support for students and faculty, organizes workshops and conferences, and sponsors visiting scholars. Students can participate in regularly scheduled seminars on the problems of western societies and can also utilize the resources of the program for fellowship inquiries and for assistance in making contacts for research abroad. Some fellowships and research assistantships are available, mainly to advanced graduate students.

Additional information may be obtained from: Professor Sidney G. Tarrow, Director, Western Societies Program, 170 Uris Hall.

### Other Programs and Studies

**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 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 14853.

**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 or her 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 American Studies Committee: Professor S. Cushing Strout, Department of English, Goldwin Smith Hall; or to Professor Richard Polenberg, Department of History, McGraw 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.

**The Center for Environmental Quality Management** brings together the faculties of the various colleges and schools in Ithaca and New York (the medical college) to study the manifold questions of environment 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, occupational health, etc. Their success has been limited, in part, because they have been unable to take into account the interdependence of environment issues. Scientific management through systems analysis has begun to make it possible to consider these multiple relationships within the framework of common objectives, 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 environ-

ment. Such an approach provides rational bases for establishing environmental quality goals and for the allocation of scarce resources to achieve these goals.

The center attempts to provide predoctoral and postdoctoral fellowships for students interested in pursuing research topics in environmental quality management. Graduate students interested in a formal course of study in environmental quality management issues may minor in the fields of environmental quality or water resources.

Further information may be obtained from Professor Walter R. Lynn, Director, Center for Environmental Quality Management, Hollister Hall.

**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. It also 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** is a division constructed horizontally across the entire University for the purpose of stimulating, developing, and supporting multidisciplinary research, training, and service programs in the fields of urban and regional studies. It functions through participation in its activities by all regularly established academic divisions having an interest in urban and regional affairs.

Administrative support and facilities are provided for faculty members and graduate students who are engaged in research projects, training programs, and service activities related to urban studies and development. These include: disciplinary, policy, and applied research encompassing all aspects of urban and regional development; training programs in regional science and heuristic gaming; and public service and extension programs in local government, planning and health services development. The center also sponsors and supports conferences and seminars on subjects within its fields of interest.

Administration of the graduate Fields of Regional Science and Urban Studies through the center 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 allow 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 Gordon P. Fisher, Director, Center for Urban Development Research, 726 University Avenue.

**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, lunar and planetary studies, 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; close to Ithaca are the Radio Astronomy and Ionospheric Laboratories. 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.)

**The Cornell-Sydney University Astronomy 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.

**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; and neurobiology and behavior. A number of fellowships, assistantships, and traineeships are available through the division.

Further information may be obtained by writing to the appropriate faculty representative.

**The Division of Nutritional Sciences** was established in 1974 to bring together faculty on the Cornell Campus whose interests and research

are primarily in various aspects of human nutrition. Both master's and doctoral degrees are awarded through the Field of Nutrition. The presence of professors from many disciplines provides Cornell with a strong but diversified sphere of nutritional science. These interests include: human and international nutrition, nutritional biochemistry, public health, general nutrition, dietetics, nutrition and behavior, nutrition and health education, and community nutrition. A number of assistantships are available through the division. Further information may be obtained by writing to: M. C. Nesheim, Director, Division of Nutritional Sciences, Savage Hall or to Willard Visek, Graduate Faculty Representative in Nutrition, Morrison Hall.

**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 of the areas represented in the MSC program, the center can help by providing funds for new equipment, laboratory supplies, and research assistantship support. In addition, the 15 Central Technical Facilities operated by the center are available to provide access to sophisticated major equipment such as electron microscopes, crystal growing furnaces, X-ray and metallography apparatus, etc. The technical staff in each facility gives advice on use of the equipment, assists with routine measurements, and is continually developing the technology of its particular area.

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

**The Laboratory for Plasma Studies** at Cornell, established in 1966, 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 oceans. 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.

Further information may be obtained by writing to Professor Peter L. Auer, Director, Laboratory for Plasma Studies, Upson Hall.

**The Program on Science, Technology, and Society** was established at Cornell in 1969 to promote interdisciplinary teaching and research on the interaction of science and technology with society. The program draws its students, faculty, and research workers from all disciplines of the University, including the physical, biological, and social sciences; the humanities; business and public administration; engineering; and law. In addition to its own innovative teaching and research efforts, it provides coherence and support for related activities in other programs and centers at the University.

Among the topics of concern to the program are technology assessment; national science policy; science, technology, and national defense; the impact of technology on social values; world population and food resources; legal and moral implications of modern biology and medicine; the sociology of science and technology; and the ecological impacts of developing technology.

**The Unit in the Humanities, Science, and Technology** was established within the STS Program to study particularly the application of humanistic insight and methods to the resolution of social problems, especially those stemming from the growth of science and technology. During the coming year the unit, under the directorship of Max Black and Stuart M. Brown, Jr., will be sponsoring courses in biomedical ethics and in the philosophy of choice and decision.

Courses within the STS Program are open to all University students who meet course prerequisites, regardless of school or departmental affiliation. A complete course listing brochure will be available at registration. Information may be obtained from the Program office, Raymond Bowers, Director, 614 Clark Hall, telephone 607/256-3810.

**The Society for the Humanities** 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, upon special application, to graduate students and suitably qualified undergraduates. The college determines if a seminar may be taken for credit. There are no examinations; normally only S and U grades are given; and it is at the discretion of the fellow whether to require only oral reports or a research paper as well. All seminars are held in the society's quarters.

Persons other than those officially enrolled may attend as visitors with the permission of the instructor.

The fellows for 1974–75 were: Charles F. Altman (Bryn Mawr College); Jean-Claude Bonne (Ecole Pratique des Hautes Etudes, Paris); James Cross (University of Liverpool); Ephim Fogel (Cornell University); Peter Hughes (University of Toronto); Lisa Jardine (Warburg Institute); Isaac Kramnick (Cornell University); Norman Kretzmann (Cornell University); James Patrick (Princeton University).

**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 Director of the Statistics Center is Professor Roger Farrell, White Hall.

**The Center for Water Resources and Marine Sciences** 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 Gilbert Levine, Director, Center for Water Resources and Marine Sciences, Hollister Hall.

### Special Facilities and Service Organizations

**ROTC (Officer Education).** As a land-grant institution chartered under the Morrill Act of

1862, Cornell has offered instruction in military science for more than one hundred years. Cornell provides this instruction through the Reserve Officers Training Corps programs of the three military departments: the Army, the Navy, and the Air Force. The ROTC programs offer graduate students the opportunity to earn a commission while completing their advanced degree. To obtain a commission in one of the armed services, students must complete a two-year course of study in an ROTC program and must meet certain physical standards. Upon completion of requirements, students receive a commission and serve a tour of active duty in the United States Army, Navy or Air Force.

Further information is provided in the *Announcement of Officer Education*, which may be obtained by writing to Cornell University Announcements, Day Hall. Interested individuals are also directed to the appropriate ROTC office in Barton Hall.

**The New York State Agricultural Experiment Station at Geneva**, 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 along with professors on the Ithaca campus as members of the Special Committees of graduate students. 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.

Further information may be obtained by writing 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 370 Model 168 located at Langmuir Laboratory in Cornell's Research Park. The 370/168 system is equipped for remote access of several kinds and designed so that very few find it necessary to visit Langmuir.

The primary terminals are high-speed reader-printers located in Upson, Clark, Uris, and

Warren Halls. These remote job-entry and delivery devices permit convenient access, job turn-around-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 370/168 system interactively. An interactive facility located in Uris Hall provides access to time-sharing terminals and consulting and programming assistance in interactive systems. Time-sharing terminals are available to individual projects that require interactive capability. Use of the 370/168 computing system by graduate students is encouraged.

Those interested in further information about the operation of the system and in consulting and programming assistance may write to the Office of Computer Services, Langmuir Laboratory.

**Cornell University Press** is the book-publishing division of the University, a nonprofit self-supporting publishing enterprise with actual printing done by various commercial firms. Founded in 1869 by Andrew D. White, Cornell's was the first university publishing venture in this country. In 1955 the Press launched the first paperback series to issue from an American university press; the Cornell Paperbacks series currently numbers 135 books. The Press now publishes 75-100 books a year including general and specialized nonfiction in all fields of interest and, occasionally, selected works of serious fiction, usually in translation. More than 25 percent of the approximately 900 books now in print were written by members of the Cornell faculty; the remainder are the works of other scholars from this country and abroad. The imprint of Comstock Publishing Associates, a division of the Press, is placed on certain books in the applied biological sciences. Cornell University Press Ltd., a subsidiary company with offices in London, distributes the Press's books to the United Kingdom, continental Europe, Africa, and the Middle East. The Press is an academic activity of the University and all books that carry its imprint have been approved for publication by the Board of Editors of the Press, which consists of members of the University faculty appointed by the president.

**Visual Aids.** The University owns and operates Photographic Services which create, or cooperate in creating, photographic studies and visual aids of all kinds.

## Cornell University

# 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 Studies, Semitic Studies, Slavic Studies, Theatre Arts**

## Architecture

**Graduate Faculty 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 work is expected to select and identify in advance the intended program of study.

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 accredited undergraduate professional program with the Bachelor of Architecture degree may be admitted as candidates for the degree of

Master of Architecture. Those who have completed four years of a six-year degree program with a major in architecture or environmental design, or have yet to receive a qualifying professional degree, should apply as transfer students to the undergraduate program since the Bachelor of Architecture is the qualifying degree at Cornell. Upon fulfilling the requirements for the Bachelor of Architecture degree, they may be admitted to the graduate program.

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 an elective program to reinforce and supplement the studio work.

Normally four terms of study are required, and the student should not anticipate completing 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 graduate faculty 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 tech-

nologies; (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.

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  
 E. Dluhosch: architectural science, building systems  
 D. P. Greenberg: architectural technology, structural analysis and design, suspension structures, computer graphics, model analysis  
 A. Kira: human engineering and psychological aspects of architecture  
 R. MacDougall: anthropological methods applied to architecture  
 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  
 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*  
 S. Bowman: visual communication systems  
 M. Dennis: architectural design, urban design  
 M. Harms: architectural design  
 G. Hascup: architectural design

L. F. Hodgden: architectural design, theory and criticism

U. Lesnikowska: architectural design

W. G. Lesnikowski: housing, building systems

A. MacKenzie: architectural design methods, urban design

E. Messick: visual communication systems

### Art

**Graduate Faculty 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 ten selected slides. Further information is available from the graduate faculty representative.

This field offers only the degree of Master of Fine Arts (M.F.A.). 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 next door to the University's Herbert F. Johnson Museum of Art.

Each candidate in the program in painting or sculpture is required to present his or her own 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 the painting staff. Students work in private 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 and proof presses.

**Faculty**

Z. Blum, J. E. Bosson, Jr., S. Bowman, V. E. Colby, N. D. Daly, K. W. Evett, G. Pederson-Krag, S. Poleskie, J. Seley, A. Singer, J. L. Squier, P. Thompson, E. Thompson

**Visiting Critic**

A. Savelli

**Chinese Literature**

**Graduate Faculty 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.

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

**Faculty**

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

**The Classics**

**Graduate Faculty Representative:** John Coleman, 25 Goldwin Smith Hall

**Major Subjects:** Ancient Philosophy, Classical Archaeology, Greek Language and Literature, Latin Language and Literature

**Minor Subjects:** Ancient History, Classical Rhetoric in the Original or Translation, Classics (when the major is in another field), Indo-European Linguistics, Medieval and Renaissance Latin Literature

Applications must include scores from the Graduate Record Examinations.

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 Ph.D. candidate is responsible for obtaining extensive knowledge of Greek and Latin authors on the official reading lists compiled by the field. Proficiency in a second modern language must also be demonstrated. 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-six volumes have appeared in the series. The volumes include grammatical, historical, and archaeological studies, and studies in classical literature and thought. The series continues to be published.

**Faculty and Specializations**

- F. M. Ahl: Roman epic and tragedy
- E. Asmis: Greek, Roman, and Hellenistic philosophy
- A. Betensky: Augustan poetry
- J. R. Clark: Roman comedy
- K. M. Clinton: Greek epigraphy, Greek and Roman religion, Greek and Roman tragedy
- J. E. Coleman: classical archaeology
- W. R. Johnson: Roman literature
- G. M. Kirkwood: Greek and Roman theatre, Greek lyric poetry
- D. L. Malone: Greek and Roman rhetoric, Roman law
- G. M. Messing: classical and Indo-European linguistics
- P. Pucci: textual criticism, Greek theatre

## Comparative Literature

**Graduate Faculty Representative:** William J. Kennedy, 244 Goldwin Smith 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 may take a master's degree in a chosen literature.

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, the principal concentration is in one national literature with minors in two others. English and American cannot be counted as separate literatures for this purpose. In the major, topics are 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), 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), C. Morón-Arroyo (Spanish), 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

**Graduate Faculty Representative:** Jean F. Blackall, 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, Prose Fiction, Old and Middle English, The English Renaissance to 1660, The Restoration and Eighteenth Century, The Nineteenth 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; however, the Field of English does not ordinarily accept applicants for the terminal Master of Arts degree. All applicants 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.

As the ratio of accepted students to applicants is approximately one to twenty, competition is extremely intense and no candidate, regardless of how strong his or her credentials may be, should presume acceptance. There are no quantitative standards for admission: all credentials are evaluated subjectively, and final decisions are made by the entire Graduate Committee. The graduate faculty representative will be happy to meet with visiting applicants; such interviews, however, have no bearing upon admission. Approximately sixteen Ph.D. candidates and eight M.F.A. candidates will be enrolled each year.

### 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 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. The 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 the first year of residence, and a total of at least six more in the second and third years. The program of any doctoral candidate's formal and informal study, whatever the particular interests, should be comprehensive enough to give 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. A student is encouraged to select one or both minors from among the offerings of related fields. A student electing to major in American studies within the Field of English will define the major to include a minor in history and will choose one minor from some non-American subject in the 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. At a series of meetings with the student the Special Committee directs and judges the student's progress by reviewing course work, individual work done with members of the committee and with others, and the student's own assessments of progress. The Special Committee of a doctoral candidate must decide before the fourth semester of graduate study whether the student is qualified to proceed toward the Ph.D.

The field expects every doctoral candidate to acquire some teaching experience as part of his or her 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 Special Committee will decide what work in these areas is most appropriate to the rest of the student's graduate program and 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 competence by, for example, presenting his or her undergraduate record, taking additional

courses in foreign languages and literatures, or translating and discussing documents related to work in English and American literature.

To pursue the study of the English language, a student may be asked to take advantage 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

The majority of students accepted for the Ph.D. program will be offered a financial aid package combining nonteaching-fellowship and teaching-assistantship support. Some M.F.A. candidates will also receive support. A student who has done graduate work elsewhere may apply for a teaching assistantship for his or her first year in the program. An applicant who wishes a teaching assistantship should check the appropriate blank of the admission-and-fellowship application.

### Faculty and Specializations

- Anglo-Saxon and medieval studies: R. T. Farrell, T. D. Hill, K. Hume, 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: M. R. Brownell, S. Budick, D. D. Eddy, S. B. Elledge  
 The Romantic period: M. H. Abrams, N. H. Hertz, S. Morgan, A. R. Parker, S. M. Parrish  
 The Victorian period: J. P. Bishop, D. M. Mermin  
 The twentieth century: H. Kaye, P. L. Marcus, D. E. McCall, J. B. Merod, 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, H. S. McMillin, B. O. States  
 Creative writing: A. R. Ammons, W. J. Harris, B. L. Hathaway, A. Lurie, J. R. McConkey, R. Morgan  
 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 Graduate Faculty Representative, English, Goldwin Smith Hall.

### Germanic Studies

**Graduate Faculty Representative:** Inta Ezergailis, 178 Goldwin Smith 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 graduate faculty 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* offered 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 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: A. J. Berger, A. Groos

The late Middle Ages, the sixteenth century: S. L. Gilman

The seventeenth century: H. Deinert, S. L. Gilman

The eighteenth century, the classical age: D. Bansberg, E. A. Blackall, D. Connor, S. L. Gilman, A. Groos

Romanticism and realism: E. A. Blackall, H. Deinert, I. Ezergailis

Twentieth-century literature: D. Bansberg, D. Connor, H. Deinert, I. Ezergailis, S. L. Gilman, W. W. Holdheim

Stylistics: E. A. Blackall

Literary theory: W. W. Holdheim

##### Linguistics

Old Norse: A. J. Berger, V. T. Bjarnar  
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  
German dialects, applied linguistics, pedagogy: H. L. Kufner

Professor-at-Large: Elizabeth M. Wilkinson

#### History

**Graduate Faculty Representative:** Daniel Baugh, 350 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. 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 are permitted to choose one of their minor fields from other fields of the Graduate School.

#### Faculty and Specializations

D. A. Baugh: modern English history, 1688–1914: political, social, economic, and administrative; maritime history of Western Europe, 1600–1800

A. H. Bernstein: ancient history, Greek and Roman; Roman Republic; sixth and fifth century Greece

S. M. Blumin: American history, social, cultural, and demographic; American urban history; history of American religion

S. G. Cochran: modern Chinese history, 1644 to present: political, social, economic, and intellectual

- E. W. Fox: modern European history; France since 1850
- A. T. Grafton: early modern European history, 1400–1650; Renaissance intellectual history
- H. Guerlac: history of early modern science; intellectual history of the seventeenth and eighteenth centuries
- T. H. Holloway: Latin American history; Brazil: social, economic, and political history in the national period
- C. Holmes: early modern English history, 1450–1688: political, legal, social, and economic
- J. J. John: medieval intellectual history; historiography; universities; Latin paleography
- M. Kammen: early American history; historical thought and American culture; New York history
- S. L. Kaplan: France, 1500–1848; comparative European social history; historical demography; quantitative approaches
- D. LaCapra: modern European intellectual history
- W. F. LaFeber: American history; U. S. foreign policy, 1750 to present
- R. L. Moore: American history, intellectual and cultural
- J. M. Najemy: late medieval and Renaissance history; Italy, 1250–1559; Florence: political, socio-economic, constitutional, and cultural history; intellectual history of Western Europe, 1300–1600
- M. B. Norton: American history, 1760–1850: social, political, and constitutional; history of women in America
- C. A. Peterson: Chinese history in the period T'ang-Sung: political, military, administrative, and foreign relations—especially late T'ang and late southern Sung
- W. M. Pintner: modern Russian history, 1700 to present, especially social, economic, military, and administrative history of the imperial period
- R. Polenberg: modern American political and social history, 1930 to present
- W. Provine: history of science; history of biology
- J. H. Silbey: American history; political behavior, especially in the nineteenth century; the Age of Jackson; the sectional controversy; Civil War and Reconstruction; quantitative methods in history
- F. Somkin: American cultural and intellectual history
- B. Tierney: medieval church history; law; political theory
- J. H. Weiss: social and economic history of Western Europe in the nineteenth and twentieth centuries; social history of technology
- L. P. Williams: history of science; nineteenth-century physical sciences
- O. W. Wolters: early Southeast Asian history; Vietnamese history to 1400
- D. K. Wyatt: modern Southeast Asian history; history of Thailand and Laos

## History of Architecture and Urban Development

**Graduate Faculty 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.

A limited number of teaching assistantships are available.

### Research and Study Opportunities

The Department of Architecture cooperates with Harvard University in the archaeological exploration of Sardis in Turkey. Qualified students are encouraged to participate as architectural assistants on this and other expeditions in the Mediterranean area.

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. 25). Research activities are closely related to and derived from faculty interests and specializations, listed below.

### Faculty and Specializations

- W. W. Cummer: ancient architecture; history of preindustrial building; archaeology
- 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
- B. G. Jones: historic preservation planning
- C. F. Otto: history of Renaissance, baroque, and modern architecture
- K. C. Parsons: history of college and university architecture and planning

- J. W. Reys: 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  
 I. R. Stewart: American urban history; nineteenth-century landscape design

**History of Art and Archaeology**

**Graduate Faculty 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 by the Fine Arts Library in Sibley Hall, with extensive holdings in art and architectural history. The Herbert F. Johnson 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-Knox 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 200,000 slides.

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. W. 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: J. V. Falkenheim, T. W. Leavitt  
 Nineteenth-century art and modern architecture: T. M. Brown  
 Oriental art: M. W. Young (Chinese and Japanese art), S. J. O'Connor  
 Renaissance and baroque art: A. S. Roe, E. G. Dotson, J. F. Scott (art of Latin America), H. P. Kahn (graphics)

**Medieval Studies**

**Graduate Faculty Representative:** Arthur B. Groos, Jr., 172 Goldwin Smith Hall

**Major Subject:** Medieval Studies

**Minor Subjects:** Medieval Art, Medieval History, Medieval Literature (English, German, Latin, Norse, Romance, Semitic, Slavic), Medieval Music, Medieval Philology (Celtic, 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 a requirement for 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 graduate faculty representative.

**Faculty and Specializations**

- B. B. Adams: medieval drama  
 F. M. Ahl: late Latin epic  
 A. J. Berger: Icelandic language and literature

- V. T. Bjarnar: Icelandic language and literature  
 R. G. Calkins: medieval art and architecture  
 A. M. Colby: Old French language and literature  
 B. Connelly: medieval Arabic  
 R. T. Farrell: Old English language and literature; English philology; medieval archaeology  
 A. B. Groos, Jr.: medieval German language and literature  
 R. A. Hall, Jr.: medieval Romance languages  
 T. D. Hill: Old English language and literature  
 K. Hume: Middle English language and literature  
 J. J. John: Latin paleography; medieval history  
 R. E. Kaske: Middle English language and literature  
 N. Kretzmann: medieval philosophy  
 G. Mazzotta: medieval Italian language and literature  
 G. M. Messing: medieval Latin language and literature  
 C. Morón-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  
 B. Tierney: medieval history; canon law  
 F. van Coetsem: Germanic philology  
 J. F. Vigorita: medieval Celtic languages and literature  
 W. Wetherbee III: medieval Latin and Middle English language and literature; Arthurian literature

## Music

**Graduate Faculty Representative:** Neal Zaslaw, Lincoln Hall

**Major and Minor Subjects:** Musical Composition, Musicology, Theory of Music, Musical Performance (minor for M.F.A. and D.M.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. 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.

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. Graduate students are expected to master specialized professional skills while continuing to develop broad interests in music and adjacent fields of study. The teachers who specialize in performance are particularly interested in new music and in newly discovered old music without neglecting the classics. Doctoral studies under the rubric of musicology frequently also include work on ethnomusicological and music-theoretical topics. Students create their own courses of study in accordance with their interests and abilities and in consultation with their Special Committees.

The Music Library, housed in Lincoln Hall, has an excellent collection of the standard research tools; its holdings consist of approximately 50,000 books and scores and 15,000 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 thirty 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 eighty 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  
 H. M. Brown, Professor-at-Large: Renaissance music; musical iconography; collegium musicum  
 J. Hsu: literature and technique of the viols and violoncello  
 K. Husa: composition; orchestration; conducting  
 S. Lubin: nineteenth-century music; music theory  
 S. Monosoff: violin; baroque violin; chamber music; performance practice  
 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. Zaslav: 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:
- E. Borroff: baroque music, American music
  - S. Chianis: ethnomusicology; organology; music history
  - P. Friedheim: nineteenth- and early twentieth-century music
  - W. Klentz: baroque music; performance practice; music aesthetics
  - H. B. Lincoln: sixteenth-century music; computers in music research
  - J. Rothgeb: music theory; analysis

A brochure more fully describing the graduate programs in music can be obtained upon request to the graduate faculty representative.

### Philosophy

**Graduate Faculty Representative:** Allen Wood, 327 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. The Field of Philosophy has no terminal M.A. program. Under very exceptional circumstances, however, the field has accepted M.A. students.

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 normally spends two years taking courses (usually three courses or seminars each semester) and preparing for the admission to candidacy examination, after which work on the thesis begins.

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, an examination will be given early in the second semester based on the written work done in the first semester and on any other materials the student 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.

The course requirements include two graduate-level courses in classics and two graduate-level courses in philosophy.

Participants should have had three years of Greek upon 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
  - 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 Studies

**Graduate Faculty Representative:** Alice M. Colby, 293 Goldwin Smith Hall

**Major and Minor Subjects:** French Linguistics, French Literature, Italian Linguistics, Italian Literature, Romance Linguistics, Romance Philology, Spanish Linguistics, Spanish Literature

Graduate study in the Romance Studies Field is designed to train students as scholars and as teachers of language and literature. The student may choose one of two main streams: literature or linguistics. Students in Romance literature are expected to acquire a basic knowledge in areas such as textual criticism, literary history, intellectual history, philology, social and political history, biography, and linguistic theory. They are also 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 students of modern literature who lack a broad and precise sense of a cultural tradition will tend to be shallow and naive; students of earlier periods, unless well advised of the literary and critical climate of our own day, may become narrowly antiquarian in their scholarship.

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 the major subject either the linguistics (descriptive and historical) of a specific Romance language or the comparative study of the Romance languages. Normally one of the minor subjects will be the literature of the language in which the person's major interest lies.

In literature, antiquated field requirements have been replaced by a flexible consultative process: the Special Committee will recom-

mend that the student acquire those languages and other skills which will be necessary to further work in his or her individually defined field of study.

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

Candidates in Romance linguistics should, in planning their programs, consult with the special adviser for this concentration, Professor Stanton P. Durham, 313 Morrill Hall.

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 or her 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 particular needs and interests.

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 strongly encourages study in related areas, e.g., comparative literature; 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, Michel Foucault, 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.

Cornell is fortunate to have in its main library, in addition to the generally strong library holdings, 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 Graduate Faculty Representative, Romance Studies.

### Faculty and Specializations

- J. Béreaud: stylistics and French civilization  
 A. M. Colby: French philology; medieval French language and literature; stylistics  
 U. J. De Winter: twentieth-century Spanish literature  
 S. P. Durham: comparative Romance linguistics; French linguistics; Gallo-Romance dialectology  
 N. Furman: nineteenth-century French literature  
 R. O. González: Golden Age Spanish and modern Spanish-American literature  
 A. Grossvogel: nineteenth- and twentieth-century Italian literature  
 D. I. Grossvogel: twentieth-century French literature  
 R. A. Hall, Jr.: comparative Romance linguistics; Italian language and literature; pidgin and creole languages  
 J. V. Harari: eighteenth-century French literature; contemporary French criticism  
 W. W. Holdheim: history of ideas; contemporary French literature  
 W. J. Kennedy: French and Italian Renaissance literature  
 L. Kerr: Spanish-American literature  
 J. W. Kronik: nineteenth- and twentieth-century Spanish literature  
 P. E. Lewis: seventeenth- and nineteenth-century French literature  
 G. Mazzotta: medieval Italian literature  
 C. Morón-Arroyo: Spanish intellectual history; medieval and modern literature  
 E. P. Morris: sixteenth-century French literature  
 J. S. Noblitt: comparative Romance linguistics; French linguistics and philology; programmed learning  
 A. Seznec: seventeenth-century French literature  
 D. F. Solá: Spanish linguistics; Quechua  
 M. Suñer: Spanish linguistics  
 L. Waugh: French linguistics; semantics

### Semitic Studies

**Graduate Faculty 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 these 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. 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, or Spanish. Candidates for the master's degree must demonstrate competence in one of these languages or in Greek, at least one term before the degree is awarded.

### Faculty

C. M. Carmichael, B. Netanyahu, D. Owen, M. Pelli, I. Rabinowitz

### Slavic Studies

**Graduate Faculty Representative:** George Gibian, 193 Goldwin Smith Hall

**Major and Minor Subjects:** Russian Literature, Slavic Linguistics

The student in Slavic studies plans an individual program in consultation with the Special Committee chairperson 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 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 to plan with the Special Committee chairperson 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 the 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
- E. W. Browne: 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
- S. Lottridge: nineteenth-century prose
- V. Ripp: nineteenth-century prose; theory of the novel; Turgenev

#### Theatre Arts

**Graduate Faculty Representative (M.A./Ph.D.):**  
Bert O. States, 212 Lincoln Hall

**Graduate Faculty 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), Cinema (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; cinema; 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. R. Cole: acting; directing; theatre aesthetics
- D. Fredericksen: cinema
- B. O. States: playwriting; dramatic theory

#### 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 and Rural Development, International Development, Landscape Architecture, Latin American Studies, Law, Linguistics, Psychology, Public Policy, Regional Science, Sociology, Statistics, Urban Studies**

#### African and Afro-American Studies

**Graduate Faculty Representative:** J. Congress Mbata, Africana Studies and Research Center

**Major and Minor Subject:** Africana Studies

The field offers a program leading to the degree of Master of Professional Studies (African and African-American) [M.P.S. (A.A.A.)]. 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 people in the twentieth century; *African Politics and Socio-political Study of Black People in America*—psychology, adaptations to changing environments, urban and rural social conditions of the black population, land-use patterns and community development, social institutions and political processes; *Afro-Literature and Black Expression*—literature, language, theatre, arts. 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. 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

**Graduate Faculty Representative:** Daniel I. Padberg, 317 Warren Hall

**Major and Minor Subjects:** Agricultural Economics, Applied Econometrics and Quantitative Analysis, Farm Management and Production Economics, International Economics and Development, Marketing and Food Distribution, Public Policy Analysis, Resource Economics

The field offers graduate training leading to the Master of Professional Studies (Agriculture), Master of Science, and Doctor of Philosophy degrees. Emphasis is placed on Ph.D. programs, though students normally are expected to obtain a master's degree first. Direct admission to a Ph.D. program may be considered if the applicant's preparation for graduate work is superior.

The Graduate School requirements for the M.S. and Ph.D. degrees (described in another section of this *Announcement*) provide for substantial flexibility in designing a student's program. The field requires that the Ph.D. student take one of the two minors in another field (e.g., Economics). A thesis is required both for the M.S. and Ph.D. degrees. The M.P.S.(Agr.) program leads to a terminal degree for those wishing to study a subject pertinent

to their profession; certain credit hour and grade point requirements are imposed for this degree.

All M.S. and Ph.D. applicants are urged to take the Graduate Record Examinations Aptitude Test; those seeking fellowships must do so. An undergraduate major in agricultural economics is not required for admission, but over-coming deficiencies in undergraduate training lengthens the graduate program.

The course work and thesis research opportunities in the Field of Agricultural Economics cover a rather broad range of topics. These include resource economics, community and regional development, public administration and finance, food economics, and international trade and traditional agricultural economics subjects such as farm management and production economics, farm finance, price analysis, agricultural policy, and marketing. Within the subject of international economics and development, staff members have special interests in Latin America, the Middle East, South and Southeast Asia, and in tropical agriculture generally. The necessary foundation courses in economic theory and quantitative methods are, of course, available. To understand the breadth of economics at Cornell, the student should review the descriptions of the Fields of Business and Public Administration, Consumer Economics and Housing, Economics, Industrial and Labor Relations, and Regional Science.

Assistantships in the Department of Agricultural Economics provide an opportunity for part-time employment in teaching, research, or extension. Thesis research is often conducted as a part of assistantship duties. Assistantship awards are made by the Department Chairperson on the basis of recommendations of the admissions committee. Applicants need only indicate on the admission form whether they wish to be considered for an assistantship.

#### Faculty and Specializations

Applied econometrics and quantitative analysis: R. N. Boisvert, R. B. How, T. D. Mount, W. G. Tomek

Farm management and production economics: C. A. Bratton, J. B. Bugliari, G. L. Casler, H. E. Conklin, C. J. Conneman, D. L. Good, E. I. 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, E. Thorbecke  
Marketing and food distribution: R. D. Aplin, D. G. Barton, E. H. Brown, M. E. Brunk, W. K. Bryant, D. L. Call, W. G. Earle, D. A. Eiler, O. D. Forker, D. C. Goodrich, R. B. How, D. R. Lifferth, D. I. Padberg, R. P. Story  
Public policy analysis: R. N. Boisvert, D. U.

Fisher, R. J. Kalter, E. A. Lutz, K. L. Robinson,  
D. G. Sisler, W. G. Tomek  
Resource economics: D. J. Allee, R. N. Boisvert,  
L. D. Chapman, R. J. Kalter

## Anthropology

**Graduate Faculty Representative:** Bernd  
Lambert, 204 McGraw Hall

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

**Minor Subjects:** 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 may choose a specialty.

A faculty committee, plus a voting graduate student elected by her or his peers, with the graduate faculty representative as chairperson, 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 deadline for completed applications is January 15.

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

Africa: R. A. Borker, V. R. Dyson-Hudson  
American Indian: C. F. Hockett  
Anthropological history and theory: D. J. Greenwood, K. A. R. Kennedy, A. T. Kirsch, B. Lambert, J. V. Murra, R. J. Smith  
Anthropological sculpture: R. Ascher  
Anthropology and architecture: R. D. MacDougall  
Applied anthropology and culture change: M. L. Barnett, R. J. Smith  
Archaeology: J. S. Henderson, T. F. Lynch  
Chinese studies: D. R. DeGlopper

Comparative religion: R. A. Borker, A. T. Kirsch, M. E. Meeker, 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  
Ecological anthropology: V. R. Dyson-Hudson, J. V. Murra, R. B. Thomas  
Economic anthropology and technology: D. J. Greenwood, J. V. Murra  
European studies: R. A. Borker, D. J. Greenwood  
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  
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  
Physical anthropology: V. R. Dyson-Hudson, K. A. R. Kennedy, R. B. Thomas  
Political anthropology: M. E. Meeker, J. V. Murra  
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, R. J. Smith  
South Asian studies: L. W. Hazlehurst, K. A. R. Kennedy, R. D. MacDougall  
Southeast Asian studies: M. L. Barnett, 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), M. N. Srinivas (Department of Anthropology, University of New Delhi, India).

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

## Asian Studies

**Graduate Faculty Representative:** J. Bruce Long,  
158 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 should not apply to Asian Studies for admission if an advanced degree is sought. Asian Studies is available as a *minor* for students admitted in 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 Special Committee, particularly with the member representing the 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-Japan Program, South Asia Program, and Southeast Asia Program.

The National Defense Education Act supports, at Cornell, language and area centers in East Asia and Southeast Asia. Languages currently offered are Burmese, Cambodian, Cebuano, Chinese (Mandarin, Cantonese, and Hokkien), Hindu-Urdu, 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, 156 Rockefeller Hall.

### Faculty and Specializations

#### China

M. G. Bernal: government  
N. C. Bodman: linguistics  
S. G. Cochran: history  
D. R. DeGlopper: anthropology  
T. C. Liu: economics  
J. McCoy: linguistics and literature  
T. L. Mei: literature and philosophy  
D. Mozingo: government; international relations  
C. A. Peterson: medieval history  
K. M. Wong: literature  
M. W. Young: art history

#### Japan

K. Brazell: literature  
R. T. Freeman: economics  
E. H. Jordan: linguistics  
T. J. Pempel: government  
R. J. Smith: anthropology  
M. W. Young: art history

#### South Asia

D. E. Ashford: government; public administration  
R. D. Colle: communication arts  
A. T. Dotson: government  
E. C. Erickson: rural sociology  
J. W. Gair: linguistics  
M. D. Glock: educational psychology  
L. W. Hazlehurst: anthropology  
M. Hugo-Brunt: city and regional planning  
G. B. Kelley: linguistics  
K. A. R. Kennedy: anthropology  
J. B. Long: religion and culture  
R. A. MacDougall: architecture  
J. W. Mellor: agricultural economics  
G. M. Messing: classics and linguistics  
S. J. O'Connor: art history  
T. T. Poleman: agricultural economics

#### Southeast Asia

B. R. O'G. Anderson: government  
M. L. Barnett: development sociology  
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  
J. T. Siegel: anthropology  
J. U. Wolff: linguistics  
O. W. Wolters: history  
D. K. Wyatt: history

#### Visiting Professors

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

## Business and Public Administration

**Graduate Faculty 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 *Announce-*

*ment 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: to enable management to control and plan the development of the enterprise and to enable 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, D. M. Barton, R. M. Battistella, F. T. Bent, H. Bierman, E. Brooks, D. R. Brown, J. B. Bugliari, S. Craig, H. J. Davidson, A. T. Dotson, R. E. Dukes, T. R. Dyckman, M. J. Esman, E. S. Flash, J. E. Hass, J. G. B. Hutchins,

S. Kelman, D. C. Knapp, A. J. Kover, R. C. Lind, T. M. Lodahl, N. R. Lyons, A. K. McAdams, J. M. McCann, J. O. McClain, V. R. Rao, J. M. Rathmell, R. Schramm, S. Smidt, R. Smiley, D. B. Smith, B. K. Stone, R. J. Swieringa, D. A. Thomas, K. E. Weick

### City and Regional Planning

**Graduate Faculty Representative:** William W. Goldsmith, 109 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.), one program leading to the Ph.D. degree, and participates in the program leading to the Master of Professional Studies (International Development) [M.P.S.(I.D.)], with a concentration in regional planning.

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. The M.P.S.(I.D.) program is restricted to persons with professional experience.

Several graduate research and teaching assistantships are available. National fellowship programs available to support study in the field include those of the Department of Housing and Urban Development, the Department of Health, Education, and Welfare, and the Loula D. Lasker Foundation. University loans are also available in special situations. There is also a work study program.

#### Aims and Operations of the Field

The two concentrations in the master's program are intended to prepare students for professional practice; the doctoral program is intended to prepare students to make creative

contributions to the field through research, teaching, policy development, and practice; and the M.P.S.(I.D.) program is intended to provide specialized training to complement previous work.

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 supporting 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 Policy Planning and Regional Analysis normally requires four residence units. Students are urged to design a program of study with their faculty advisers which takes into account their background and interests and the substantive and methodological courses needed for them to develop a professional planning competence appropriate for the master's degree. Students can pursue a more general program or can focus their study in various areas of application such as: regional planning, social policy planning, regional economics and development planning, urban and environmental systems planning, health planning, housing, and urban information systems, and others. Field work experience, either during the summer between the two years or in course work during the academic year is recommended. Depending upon their interests, students may take up to one half of their course work in electives in other related departments at Cornell. Demonstration of an ability to do independent work in the form of a project or thesis is also required for the M.R.P. degree.

The M.P.S.(I.D.) concentration in regional planning, also administered through the Department of Policy Planning and Regional Analysis, requires two residence units and is administered through the Field of International Development. Course work in regional planning and in a selected area of methodology must be supplemented with a final research project.

The concentration in the master's program administered through the Department of Urban Planning and Development requires four residence units. During the first year students pursue required foundation courses in urban planning and development, environmental planning and design, urban theory, and planning theory and analysis. They also develop 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 or project complete the program.

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 the 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

Faculty and students in the field have engaged in a variety of specialized training programs and research projects. These change from year to year, but recent examples of the former include a work-study training and local government assistance program offered in cooperation with the New York State Office of Planning Services and U.S. Public Health Service Environmental Planning Traineeships. Major research projects include a study of the effects of natural disasters, studies of city hierarchies in Colombia and Chile, a history of urban development and planning in the American southeast, an econometric model of the New York State economy, a study of the impact of industrial locations on regional economics, and studies of New Town projects in New York State and abroad. Research is carried out within the departments as well as within such specialized units as the Center for Urban Development Research, the Center for International Studies, and the Water Resources and Marine Sciences Center.

### Faculty and Specializations

- P. L. Bereano: environmental planning, policy, and law; technology assessment  
 P. Clavel: planning theory and administration  
 S. Clemhout: environmental planning; public policy; quantitative analysis

- 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; ghetto development; urban and regional planning in developing countries; Latin American studies  
 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  
 D. B. Lewis: development planning; regional and economic planning in developing countries; technology transfer; quantitative methods  
 D. W. Nelkin: planning; science-technology and society  
 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  
 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  
 I. R. Stewart: urban politics; American urban history  
 B. H. Swift: health planning; social policy; systems theory; public administration  
 D. F. Williams: planning theory; housing in developing nations; urban public sector economic analysis; minority subgroup economic development

### Communication Arts

**Graduate Faculty Representative:** Robert H. Crawford, 640 Stewart Avenue

**Major and Minor Subjects:** Communication Arts

The field offers graduate training leading to the degree of Master of Professional Studies (Communication Arts). Candidates for the

master's or Ph.D. degrees in other fields may minor in 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 communication problems. Focus of the program is on the strategic application of communication knowledge and technology (both mass media and interpersonal) to specific problems in society, rather 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

N. E. Awa, J. A. Barwind, R. D. Colle, R. H. Crawford, C. H. Freeman, H. Kim, J. E. Lawrence, R. D. Martin, C. C. Russell, V. R. Stephen, W. B. Ward, S. A. White

### Consumer Economics and Housing

**Graduate Faculty Representative:** Elizabeth Wiegand, 120-B Martha Van Rensselaer Hall

**Major and Minor Subjects:** Consumer Economics, Housing, 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; theories of consumption; and family decision making to allocate resources.

**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.

**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, planning, and community decision making within the larger economic-socio-political framework.

#### Faculty and Specializations

- L. L. Bower: production of housing; housing finance
- W. K. Bryant: consumer economics; public policy
- G. J. Bymers: consumption economics; consumer problems; marketing
- S. Clemhout: economic theory; welfare economics
- A. J. Davey: family decision making
- M. Galenson: consumption economics; consumer and the law
- A. J. Hahn: community decision making; public policy
- C. Meeks: housing
- J. R. Robinson: consumer economics
- N. Saltford: marketing; consumer economics
- R. E. Steidl: family decision making
- K. E. Walker: home management; time-use research
- E. Wiegand: consumer economics; family financial management

## Design and Environmental Analysis\*

**Graduate Faculty Representative:** G. Cory Millican, 318 Martha Van Rensselaer Hall

**Major and Minor Subjects:** Design, Environmental Analysis

The Design and Environmental Analysis Field offers graduate study leading to the M.A., M.S., or M.P.S. (Human Ecology) degree. To have both a major and a minor within the field is not recommended. Candidates for the Ph.D. degree in other fields may minor in this field.

Study in Design and Environmental Analysis is directed toward improving both the quality of products used by consumers and the environments in which they are used. The study of consumer products such as clothing, textiles, housing, household appliances, and home furnishings includes the functional relationship of the user to the products. Interior spaces of interest include family dwellings, institutional living arrangements such as homes for retired persons, and occupational settings.

The study of consumer products and interior spaces is approached from the discipline bases of design and the arts, physical sciences, and behavioral sciences. Students ordinarily develop strength in one of these discipline areas and coordinate knowledge from the others as they solve problems and study issues concerning the needs of individuals and families as they function in the near environment.

Students majoring in design focus on consumer product design, interior design, or space planning. Students in one area of environmental analysis concentrate on some aspect of a consumer product such as basic characteristics, use, or marketing. In another area of environmental analysis the students focus on the interaction of space, furnishings, and facilities in the near environment and the influence of human and social behavior. The development of methodology for research is an important aspect of this area.

Admission to graduate work is based primarily on evidence of the student's capability for advanced study. In addition to credentials required by the Graduate School, candidates desiring a design major are required to submit visual material (slides or a portfolio of work). Candidates wishing to major in environmental analysis should submit the results from either the Graduate Record Examinations Aptitude Test or the Miller Analogies Test. To be considered for certain scholarships and fellowships, design majors must also submit results from one of these tests.

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

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

Students wishing to specialize in environmental analysis should have preparation in one or more of the following: textiles and clothing, household equipment, chemistry, basic mathematics, physics, economics and marketing, home management, social psychology, industrial psychology, or engineering fields such as engineering psychology or industrial engineering.

About two-thirds of the graduate students in the field hold teaching or research assistantships. Fellowships are available to students with specialized interests in textiles and clothing.

### Research and Study Opportunities

The field has well-equipped studios and workrooms, 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*

- A. R. Bushnell: interior space planning; consumer product design
- J. A. Carreiro: housing design; product design
- G. C. Millican: architectural and design history; interior design
- C. J. Straight: visual design

#### *Environmental Analysis*

- F. D. Becker: social and environmental psychology
- G. J. Coates: design methods; residential environments; environments for children
- B. A. Lewis: textile chemistry; environmental analysis
- E. R. Ostrander: assessment methodology; behavioral science—design collaboration
- E. Peters: textiles and fibers; consumer product safety; environmental analysis
- M. E. Purchase: selection, use, and care of household equipment, furnishings, and materials in the near environment; prevention, analysis, and removal of household soil
- N. C. Saltford: textile marketing; environmental analysis
- R. E. Steidl: functional design criteria for interior spaces and consumer products; activity and human resource management at different stages of the family life cycle
- M. V. White: science and technology of consumer textiles

## Development Sociology

**Graduate Faculty Representative:** E. Walter Coward, Jr., 438 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 the United States and other nations, 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 the special area of interest, such as Latin America, South Asia, or Southeast 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

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 develop-

ment, decision making in farm families, development of American rural society, social organization of agriculture, 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. For some research areas, graduate assistants who have or are willing to acquire a background in basic agricultural and biological disciplines are sought. Research is being conducted by field members in numerous countries including Brazil, Ethiopia, Indonesia, Italy, Laos, Malaysia, Mexico, The Netherlands, Pakistan, Peru, and the Philippines. There are also several research activities using as units of analysis nations and their administrative subdivisions (states, provinces, counties, districts).

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 units (New York State and the Northeast Region). 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,

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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

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

### Economics

**Graduate Faculty Representative:** S. C. Tsiang, 422 Uris Hall

**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

All applicants 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 chairperson of the Special Committee explicitly approves an exemption) mathematical economics.

Applications for teaching assistantships should

be made directly to the graduate faculty representative of the Department of Economics.

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

### Faculty and Specializations

Econometrics and economic statistics: R. H. Frank, T. C. Liu, M. Majumdar, R. E. Schuler, W. Taylor  
Economic development and planning: E. I. Burton, M. G. Clark, T. E. Davis, R. T. Freeman, F. H. Golay, M. Haines, J. Mellor, G. J. Staller, E. Thorbecke, J. Vanek, H. Y. Wan, Jr.  
Economic history: T. E. Davis, M. Haines, J. G. B. Hutchins, P. McClelland, W. Taylor  
Economics of participation and labor-managed systems: T. E. Davis, D. C. Mueller, G. J. Staller, J. Vanek  
Economic theory: W. Brock, E. T. Burton, R. H. Frank, G. H. Hildebrand, T. C. Liu, M. Majumdar, P. Pestieau, U. Possen, R. E. Schuler, S. Slutsky, S. C. Tsiang, J. Vanek, H. Y. Wan, Jr.  
History of economic thought: G. H. Hildebrand  
Industrial organization and control: E. A. Blackstone, A. E. Kahn, D. C. Mueller, W. Taylor  
International economics: T. E. Davis, R. T. Freeman, F. H. Golay, 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, R. E. Schuler, S. Slutsky  
Regional science: W. Isard

### Education

**Graduate Faculty Representative:** Harrison A. Geiselmann, 15 Stone Hall

**Major and Minor Subjects:** Agricultural and Occupational Education; Community Service Education; Counseling and Student Personnel Administration in Higher Education; Curriculum and Instruction; Economics, History, Philosophy, and Sociology of Education; Educational Administration; Educational Psychology and Measurement; Educational Research Methodology; Extension and Continuing Education; Home Economics Education; Science and Environmental Education

The field is concerned with the scholarly study of education through relevant disciplines, through the development of basic theory and research, and through the application of theory and research to contemporary education problems.

Students prepare for positions in public and private school systems, two- and four-year colleges, universities, state and federal educational agencies, government, and industrial enterprises, both in the United States and overseas. In addition to the usual university teaching and research positions, specialized educational careers include administration, teacher education, counseling, instructional materials development, and organizational planning.

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 score of the Miller Analogies 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., and the professional degrees of Master of Arts in Teaching, Master of Professional Studies (Agriculture), Master of Professional Studies (Human Ecology), and Doctor of Education. (See p. 17.)

### Faculty and Specializations

#### *Agricultural and Occupational Education*

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

The program in agricultural and occupational education focuses on preparing students for specialized positions as teacher educators in agriculture and administrators of occupational education enterprises. Candidates are encouraged to take substantial course work in a related field of study that will contribute to professional and technical competence.

Current research and development activities at secondary and college levels include curriculum development, evolution of instructional support systems, development and evaluation of instructional materials, assessment of preservice and inservice needs of occupational educators, development and implementation of the career education concept, improvement of college teaching, and the explication of alternative procedural models for adult education. Students have frequent opportunities for involvement in projects sponsored by the Cornell Institute for Research and Development in Occupational Education, including competency based teacher education.

#### *Community Service Education*

I. Lazar, coordinator; J. Archibald, R. J. Babcock, D. Barr, S. E. Blackwell, A. Davey, C. Farris,

J. Ford, I. I. Imbler, M. E. Minot, B. J. Mueller, H. Y. Nelson, L. A. Noble, K. Rhodes, L. Street, J. Wright, B. L. Yerka

The program in community service education focuses on analysis of a wide range of community services intended to help people improve or maintain the quality of everyday life. The aim of such analysis is to identify skills required by human service professionals and auxiliary workers, to design appropriate educational and social programs, and to develop methods of coordinating and evaluating human services.

Current research interests include: development of consolidated human services systems; study of ethnically owned communities; effectiveness of paraprofessionals in community service; concepts of individual family and community differentiation; methodologies to measure consumer responses; design of service and income maintenance systems for aged, blind, and disabled persons; and evaluation of tenant information programs.

#### *Counseling and Student Personnel Administration in Higher Education*

K. M. Moore, coordinator; H. G. Andrus, D. J. Barr, J. R. Egner, J. Failing, D. E. Hedlund, W. J. Pauk, R. E. Ripple

The program in counseling and college student personnel administration is an interdisciplinary behavioral science study concerned with the administration of higher education and with the application of psychological counseling and intervention skills to effect change on an individual, group, or organizational level.

Current research interests include counseling in higher education, student-faculty relations, women in two-year colleges, occupational decision making, occupational education curriculum development in two-year colleges, and placement services in collegiate institutions.

#### *Curriculum and Instruction*

G. Posner, coordinator; B. Adams, J. P. Bail, W. L. Brittain, R. L. Bruce, W. E. Drake, H. A. Geiselmann, D. B. Gowin, D. Henderson, B. Nichols, J. D. Novak, K. Rhodes, R. E. Ripple, V. N. Rockcastle, F. H. Stutz, H. Wardeberg, J. Wilcox

The program in curriculum and instruction is devoted to study of the curriculum and its relation to instruction. Students may focus on the curricula of subject areas such as science, mathematics, reading, and occupational education, or on general curriculum topics from various disciplinary perspectives such as philosophy, psychology, and sociology. A strong foundation in the basic concepts and skills of curriculum development and instructional planning is expected.

Current research deals with such areas as the design of courses, the improvement of college

teaching, curriculum organization, curriculum development and evaluation in higher education, and the relationship between theories of learning and the curriculum.

*Economics, History, Philosophy, and Sociology of Education*

K. A. Strike, coordinator; D. B. Gowin, E. J. Haller, S. Klees, K. M. Moore, F. H. Stutz

Students in this program specialize in one or more of the cognate disciplines underlying the social, cultural, and intellectual context of education. Philosophy of education pursues the analysis of conceptual problems and of values. History of education is concerned with the educational heritage, with comparative educational systems, and with the development of college and university systems. Sociology of education deals with the social structures of schools and classrooms and sociology of the teaching profession. Economics of education is concerned with resource allocation within the educational system and with analysis of relationships between the educational system and the society as a whole.

Current research deals with philosophy of the behavioral sciences, political and legal philosophy, political socialization, and decision making from a disciplinary perspective.

*Educational Administration*

L. B. Hixon, coordinator; J. P. Bail, R. L. Bruce, R. E. Doherty, J. R. Egner, E. J. Haller, K. M. Moore, K. A. Strike, F. H. Stutz, H. Wardeberg, J. Wilcox

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

In addition to these general requirements, the candidate is permitted to concentrate on the administration of public schools or colleges and universities, or to focus on the specialized position of professor of educational administration.

Current research interests include: regional studies; organizational consequences of planning, programming and budgeting systems; political socialization of school children; school paraprofessionals; procedural models for organizing and conducting occupational education programs; career decision making.

*Educational Psychology and Measurement*

R. E. Ripple, coordinator; H. G. Andrus, M. D. Glock, J. Harding, H. Levin, J. Maas, G. W. McConkie, J. Millman, W. Pauk

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, coordinator; 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, identifying limitations and advantages, and projecting judgments about consequences of their use in the educational enterprise. Students take work in applied statistics, methods of program evaluation, and conceptual problems in educational inquiry.

Current research interests include program evaluation, instructional objectives validation, teaching performance tests, and models for training of researchers.

*Extension and Continuing Education*

J. P. Leagans, coordinator; G. Broadwell, R. L. Bruce, I. I. Imbler, L. A. Noble, J. Wright

The program in extension and continuing education focuses on understanding the nature and role of the continuing education process for adults and how to utilize it effectively as the activating force in planned programs of economic and social change. The curriculum is interdisciplinary and 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.

Current research interests include: the structure of extension and other continuing education organizations for adults; design of programs; learning and communication processes; and evaluation of programs.

*Home Economics Education*

H. Y. Nelson, coordinator; S. Blackwell, J. Ford, I. Lazar, M. E. Minot, B. J. Mueller, L. A. Noble, K. Rhodes

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 tenant education designed for socioeconomically 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*

V. N. Rockcastle, coordinator; R. B. Fischer, J. D. Novak

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.

## Government

**Graduate Faculty Representative:** Myron Rush, 130 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.

Students are asked to acquire: (1) a thorough knowledge of the discipline, including substantial theoretical, conceptual, 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. If 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, including an oral qualifying examination.

By the end of the third year of residence, or sooner if possible, the student is expected to have taken the admission to candidacy examination. The examination is given in two parts: (1) written examinations in the student's major and minor subjects and (2) 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 at most four years. Both the admission to candidacy examination and the approval of thesis examination are open to all faculty members.

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 the student presents a thesis proposal, outlining the hypotheses, data, methods, and resources needed to successfully complete the 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, South-east 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
- B. Ginsberg: public policy; parties

- E. W. Kelley: public 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  
 M. Shefter: urban politics; parties  
 D. Van Houweling: urban politics; political economy  
 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: England: comparative local politics, political development, public policy  
 M. Bernal: China: ideology and politics  
 A. T. Dotson: development administration  
 M. J. Esman: comparative public administration and political development; public policy  
 G. McT. Kahin: Southeast Asia  
 P. J. Katzenstein: Western Europe  
 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 and Italy: parties and elections  
 N. T. Uphoff: political economy, West Africa; development theory; public policy

#### *Political Thought*

- W. J. Dannhauser: Hegel, Marx, Nietzsche  
 E. Eisenach: Hobbes, Locke, and the liberal tradition  
 I. Kramnick: British radicalism; intellectual history  
 D. Resnick: contemporary political and social thought

#### *International Relations*

- M. J. Esman: foreign aid; international flows of technology  
 G. McT. Kahin: foreign relations of Southeast Asia  
 P. J. Katzenstein: political integration  
 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; political behavior  
 D. J. Danelski: quantitative judicial behavior  
 E. W. Kelley: coalition theory; mathematical and statistical reasoning; philosophy of science  
 S. Tarrow: voting behavior and electoral studies

- D. Van Houweling: data analysis; computer simulation techniques  
 R. Weissberg: socialization; voting behavior; survey research

## Hotel Administration

**Graduate Faculty Representative:** Stanley W. Davis, Statler Hall

**Major Subjects:** Hotel Accounting, Hotel Administration

**Minor Subjects:** Food and Beverage Management, Hotel Accounting, Hotel Administration, Personnel Administration and Training, Properties Management, Travel Industry Management

In addition to meeting the requirements of the Graduate School each applicant must show evidence of significant experience in the hospitality industry or in a related field. Further, it is required that each candidate arrange for a personal interview with a representative of the Graduate Admissions Committee of the School of Hotel Administration. Not all prospective students can readily come to Ithaca; therefore, arrangements have been made with graduates and others active in the hotel and restaurant business to serve as interviewers in most of the principal cities of the world. A time and place for this interview should be requested from the Admissions Office, School of Hotel Administration, Statler Hall.

The deadline for submitting an application is February 1. The deadline for completion of the application materials and personal interview is March 1. M.P.S.(H.Ad.) candidates are normally admitted only at the beginning of the academic year although a few admissions are made in January. Application deadline for spring admissions is October 1.

The field offers the following degrees: Doctor of Philosophy, Master of Science, and Master of Professional Studies (Hotel Administration). The Ph.D. degree program is specifically aimed at preparing those exceptional students who plan to teach at the college level or to do research in the field. The M.S. is also aimed at preparing teachers and researchers.

Candidates for the M.S. must have completed the B.S. in Hotel Administration from Cornell University. The M.P.S.(H.Ad.) is less research oriented than the M.S. and is designed to provide a major area of concentration and study in greater depth.

There are three different approaches to the M.P.S.(H.Ad.) degree depending upon the applicant's prior study: (1) for those with a bachelor's in a field other than hotel administration 64 credit hours (two years minimum) will be required; (2) for those with a B.S. in

hotel administration 32 to 64 credit hours (one to two years) will be required; and (3) for those with a B.S. in hotel administration from Cornell University 32 credit hours (one year minimum) will be required. In addition to the course hours, one unit of practice credit, as defined in the *Announcement of the School of Hotel Administration*, must be earned between the time of matriculation and award of degree. A master's monograph must be presented during the last term of work for this degree.

#### Faculty and Specializations

Accounting and financial management:

D. C. Dunn

Economics: W. H. Kaven, H. J. Recknagel

Food and beverage management: V. A.

Christian, M. H. Ericson

Hotel management: R. A. Beck, P. L. Gaurnier

Law: J. E. H. Sherry

Microbiology and sanitation: J. C. White

Properties management: J. J. Clark

Psychology: S. W. Davis

### Human Development and Family Studies

**Graduate Faculty Representative:** John Doris, 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 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 the family within the social context.

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 two years for completion; doctoral programs, about four years. The policy of the field is to attempt, whenever possible, to provide financial support

for master's degree candidates during their first two years of study and for Ph.D. candidates during their first four years of study, provided that their work is satisfactory.

#### Special Facilities and Programs

About one-half of the research in the Human Development and Family Studies Field is conducted in the departmental laboratories and nursery school; the other half is done off-campus in various community settings. The departmental nursery school maintains half-day programs for children from diverse backgrounds. An art laboratory is available for the investigation of creative activities in children from two to fifteen years of age. Several small experimental rooms and two large rooms are equipped with one-way vision screens and modern sound recording equipment. In addition, closed-circuit television facilities are available for teaching and research.

The department maintains close relationships off-campus with many of the public schools, nursery schools, day care centers, youth serving agencies, and counseling services in Tompkins County. A great deal of departmental research is conducted in these settings. Students who major or minor in Child and Family Psychopathology take a series of seminars and practica intended to prepare them to conduct research in clinical settings.

The field maintains close relationships with the Field of Psychology, and the two fields jointly sponsor a program of research and training in cognitive development.

#### Faculty

A. L. Baldwin, C. P. Baldwin, H. T. M. Bayer, A. W. Boykin, W. L. Brittain, U. Bronfenbrenner, M. Cochran, J. C. Condry, E. C. Devereux, Jr., J. Doris, H. Feldman, E. J. Gibson, H. Ginsburg, J. S. Harding, J. Hill, B. Koslowski, W. W. Lambert, J. Laws, L. C. Lee, E. Lenneberg, H. Levin, U. Neisser, M. Potts, H. N. Ricciuti, B. Rosen, D. Roy, G. Streib, J. M. Stycos, G. J. Suci, P. Taietz

### Industrial and Labor Relations

**Graduate Faculty 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 History*

J. O. Morris, chairperson; G. W. Brooks, D. E. Cullen, C. Daniel, R. E. Doherty, J. A. Gross, K. L. Hanslowe, V. H. Jensen, T. Kochan, M. R. Konvitz, A. G. Korman, D. B. Lipsky, J. T. McKelvey, R. B. McKersie, 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, 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*

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

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*

M. G. Clark, chairperson; R. L. Aronson, R. H. Ferguson, W. Galenson, G. H. Hildebrand, D. M. MacIntyre, F. Slavick, R. Smith, 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, chairperson; T. DeCotiis, L. D. Dyer, J. Farley, F. F. Foltman, W. W. Frank, 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*

G. Gordon, chairperson; H. E. Aldrich, J. Bachrach, L. W. Gruenfeld, T. H. Hammer, N. A. Rosen, 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 and Rural Development

**Graduate Faculty Representative:** Edwin B. Oyer, 102 Roberts Hall

**Major and Minor Subject:** International Agricultural and Rural Development [major for the M.P.S.(Agr.) degree only]

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 condi-

tions 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. Students minoring in this field are encouraged to become proficient in that language which will most likely be useful in their intended area of service.

Students may not minor in this field if they are minoring in one of the area programs such as Asian Studies or Latin American Studies, and they may not select a professor for this minor who also serves on the graduate faculty in their major field.

The field does offer an M.P.S.(Agr.) degree for students interested in the broader, more interdisciplinary aspects of agricultural and rural development. The program provides an opportunity for study of development strategies, a broad perspective on practices and trends in world agriculture, and up-to-date training in a discipline. The curriculum is especially relevant to mature and experienced practitioners in development activities from the United States and abroad.

#### Faculty

D. E. Ashford, M. L. Barnett, S. L. Barraclough, C. W. Boothroyd, F. B. Cady, H. R. Capener, R. D. Colle, H. E. Conklin, J. W. Converse, E. W. Coward, R. H. Crawford, L. V. Crowder, M. Drosdoff, E. C. Erickson, M. J. Esman, D. K. Freebairn, F. H. Golay, D. J. Greenwood, W. K. Jordan, W. C. Kelly, G. C. Kent, F. V. Kosikowski, M. C. Latham, D. J. Lathwell, J. P. Leagans, G. Levine, H. A. MacDonald, R. E. McDowell, J. W. Mellor, H. M. Munger, R. P. Murphy, R. B. Musgrave, E. B. Oyer, T. T. Poleman, Jr., K. L. Robinson, J. L. Saunders, M. L. Scott, D. G. Sisler, K. H. Steinkraus (at Geneva), E. L. Stone, Jr., R. D. Sweet, H. D. Thurston, N. Uphoff, D. H. Wallace, F. W. Young

#### International Development

**Graduate Faculty Representative:** Milton J. Esman, 170 Uris Hall

**Major Subject:** International Development

The field offers graduate training leading to the degree Master of Professional Studies (International Development) [M.P.S.(I.D.)]. It provides an interdisciplinary course of study for experienced practitioners in international development who seek to upgrade or update their educational qualifications in areas of direct relevance to their professional careers. The program offers training both in a substantive specialization—nutrition, regional planning, or population—and in methods of analysis for implementing development objec-

tives—development administration and planning, development economics, development politics, development sociology, or international communication. While applicants should have a strong academic background, excellent professional performance will be given a large weight in evaluating the applicant's admissibility. Most applicants will be expected to have complete funding from outside sources.

The degree program consists of at least thirty credit hours of course work, of which six credit hours will normally consist of an applied research project. Approximately half of this work will be in one of the three substantive specializations and half in one or more of the methods of analysis. Candidates can expect to complete their degree requirements within a time period of eleven to eighteen months. Where more work in the substantive specialization is desired, the candidate is expected to do it in a summer of work before or after the academic year, or in an additional term of work.

#### Faculty and Specializations

##### *Nutrition*

D. L. Call, M. C. Latham, D. A. Roe, D. M. Sanjur, R. Schwartz, D. G. Sisler

##### *Regional Planning*

W. W. Goldsmith, B. G. Jones, D. B. Lewis, S. Saltzman, D. F. Williams

##### *Population*

P. S. K. Chi, R. D. Colle, R. H. Crawford, M. Haines, L. Reissman, J. M. Stycos

##### *Methods of Analysis*

D. E. Ashford, M. L. Barnett, J. W. Converse, E. W. Coward, T. E. Davis, M. J. Esman, F. H. Golay, J. W. Mellor, N. T. Uphoff, F. W. Young

Professors mentioned under the three substantive specializations may also work in methods of analysis for international development.

#### Landscape Architecture

**Graduate Faculty Representative:** Joseph Gentili, 209 West Sibley Hall

**Major and Minor Subject:** Landscape Architecture

The two-year Master of Landscape Architecture (M.L.A.) program is designed primarily for individuals who wish to practice, conduct applied research, or teach in the field of landscape architecture. A secondary objective of the program is to provide increased educational opportunities to students of architecture, city and regional planning, civil and environmental engineering, design and environmental analysis, natural resources, and other related fields.

The emphasis of the program is on the systematic inventory, analysis, and synthesis of data from diverse disciplines for the practical

purposes of planning and designing modifications of the natural environment. The design processes are concerned with user needs for man-made physical space and the relationship of that space to the natural environment. The program should be distinguished from training programs concerned mainly with environmental systems engineering or environmental quality control.

Applicants are expected to hold a bachelor's degree in architecture, landscape architecture, environmental design, planning, or a similar field.

Undergraduate academic performance, Graduate Record Examinations scores (optional), examples of work, letters of recommendation, and the applicant's statement of program-related objectives, considered collectively, must indicate a level of ability adequate to the successful completion of the program.

A total of sixty credit hours of course work and at least one academic year of residence are required for the M.L.A. degree. Requirements for the degree also include an approved summer internship experience and completion of a thesis or final project. Six credit hours will be granted for the thesis or final project. A student may petition the Graduate School for a maximum of one semester's advanced standing based upon previous education or experience.

A minor area of concentration may be chosen prior to the beginning of the second semester of study and should consist of a minimum of fifteen credit hours of course work in any of the relevant fields in the Graduate School or from the following selective list: ecologic systems determinants of landscape design, historic aspects of landscape design, legal determinants of landscape design, or social determinants of landscape design.

#### Faculty

M. Adleman, D. J. Allee, D. J. Belcher, R. W. Crump, J. F. Gentili, K. H. Grey, L. S. Hamilton, E. E. Hardy, M. Hugo-Brunt, S. W. Jacobs, B. G. Jones, T. Liang, A. L. Lieberman, C. W. Pearman, J. P. Shaw, S. W. Stein, P. S. Tresch, O. M. Ungers

#### Latin American Studies

**Graduate Faculty Representative:** W. W. Goldsmith, 190E Uris.

**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 the 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 generates the 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 in the area.

#### Faculty

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

#### Law

**Graduate Faculty Representative:** John J. Barceló, 404 Myron Taylor Hall

**Major and Minor Subject:** Law

The Master of Laws (LL.M.) and the Doctor of Science of Law (J.S.D.) degrees are conferred. The former is intended for the students who desire to increase their knowledge of law by work in a specialized field. The latter is intended for students who desire to become legal scholars 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 noncandidates (non-degree 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. Applicants should state in as much detail as possible the objective for which they wish to do advanced graduate work and the particular fields of study they wish 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 the 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, criminal 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, P. A. Barald, J. J. Barceló, H. Bitner, G. R. Blakey, J. Brown, K. M. Clermont, R. C. Cramton, W. D. Curtiss, W. T. Dean, W. R. Forrester, W. G. Gifford, Jr., K. L. Hanslowe, H. G. Henn, W. E. Hogan, M. R. Konvitz, I. R. MacNeil, P. W. Martin, R. S. Pasley, N. Penney, D. L. Ratner, E. F. Roberts, Jr., F. F. Rossi, R. B. Schlesinger, R. S. Summers, G. Thoron, H. L. Warren, I. Younger

## Linguistics

**Graduate Faculty Representative:** R. B. Jones, Jr., Morrill Hall

**Major Subject:** General Linguistics

**Minor Subjects:** Applied Linguistics, General Linguistics, Sociolinguistics

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

For the Ph.D., a qualifying examination 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 prior to a Ph.D. degree.

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), as well as the Indo-European languages.

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

L. H. Babby: Slavic linguistics  
 N. C. Bodman: Chinese and Sino-Tibetan linguistics  
 J. S. Bowers: transformational grammar  
 S. P. Durham: French 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  
 C. F. Hockett: anthropological linguistics  
 F. E. Huffman: general linguistics; Mon-Khmer linguistics  
 R. B. Jones: general linguistics; linguistics of Southeast Asia  
 R. L. Jones: Germanic linguistics  
 E. H. Jordan: Japanese linguistics; language pedagogy  
 R. E. Kaske: English linguistics  
 G. B. Kelley: Dravidian; general linguistics; sociolinguistics  
 H. L. Kufner: Germanic linguistics  
 R. L. Lead: Slavic linguistics; general linguistics  
 J. McCoy: Japanese and Chinese linguistics; Chinese dialects  
 G. M. Messing: Classical linguistics; Indo-European

- J. S. Noblitt: Romance linguistics; programmed learning  
 D. F. Solá: Spanish linguistics; Quechua  
 G. J. Suci: psycholinguistics and language acquisition  
 M. A. Suñer: Spanish linguistics  
 F. van Coetsem: Germanic linguistics  
 J. F. Vigorita: Celtic linguistics; Indo-European  
 L. R. Waugh: general linguistics; French linguistics  
 J. U. Wolff: general linguistics, Malayo-Polynesian linguistics

## Psychology

(See p. 79.)

## Public Policy

**Graduate Faculty Representative:** Norman Uphoff, 170 Uris Hall

**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 to deal with problems 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. D. Chapman, P. Clavel, S. Clemhout, E. T. Cranch, T. E. Davis, A. T. Dotson, P. A. Eberts, E. C. Erickson, M. J. Esman, E. S. Flash, Jr., W. W. Goldsmith, A. J. Hahn, K. L. Hanslowe, C. S. Hershey, J. G. B. Hutchins, B. G. Jones, R. J. Kalter, J. E. Knitzer, O. F. Larson, I. Lazar, R. C. Lind, F. A. Long, D. P. Loucks, T. J. Lowi, J. W. Mellor, B. J. Mueller, D. C. Mueller, M. V. Nadel, D. W. Nelkin, G. H. Quester,

- R. Rosecrance, S. Saltzman, R. Schramm, R. E. Schuler, R. S. Summers, N. T. Uphoff, J. Vanek, D. F. Williams

## Regional Science

**Graduate Faculty Representative:** Stan Czamanski, 108 W. Sibley Hall

**Major and Minor Subject:** Regional Science

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.

There are no fixed admission requirements, but grades, class standing, GRE scores, and letters of recommendation must collectively indicate superior ability for creative research.

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.

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 sciences, 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. J. Allee: resource economics; regional economics; regional development planning
- F. J. Cesario: transportation economics; travel demand modeling; spacial statistics; recreation economics and planning; environmental management and pollution; public systems analysis
- S. Czamanski: economic analysis for planning (including urban growth models); regional social accounts; regional applications of input-output analysis; location theory; housing economics
- G. P. Fisher: transportation; systems analysis; engineering economics; policy analysis
- W. W. Goldsmith: regional development planning and administration; economic analysis; urban and regional planning in developing countries
- W. Isard, Visiting Professor: regional input-output analysis; gravity models; location theory; environmental management; general social science theory
- B. G. Jones: urban and regional quantitative analysis; urbanization theory; planning theory; environmental health planning
- R. J. Kalter: economic evaluation of public investment; water projects; recreation; environmental quality
- T. C. Liu: econometrics; economic statistics
- D. P. Loucks: mathematical modeling of water resources and environmental quality management systems; urban noise control; regional development; multi-objective evaluation methods; engineering-economic-ecologic systems analysis
- W. R. Lynn: environmental systems; planning and public policy issues
- A. H. Meyburg: transportation systems; urban transportation planning; travel demand modeling; urban goods movements; airport planning and operations; transportation impact analysis
- S. Saltzman: quantitative methods and systems analysis in planning; computers and information-processing systems
- R. E. Schuler: urban and spatial economics; public finance and environmental economics

**Sociology**

**Graduate Faculty Representative:** Bernard C. Rosen, 344 Uris Hall

**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

All inquiries about the graduate program in sociology should be made directly to the graduate faculty representative. A brochure,

*Sociology at Cornell*, will be sent on request. Graduate Record Examinations scores are required.

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 is 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 four years of the A.B. degree. A diagnostic qualifying examination may be held at the request of the student or the 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 by the faculty have been done in cross-cultural settings: Africa, Asia, Latin America, and Europe. Staff members also participate in the Center for International Studies and various area study programs.

Comparative: R. Avery, R. K. Goldsen, J. A. Kahl, W. W. Lambert, B. C. Rosen, W. F. Whyte, R. M. Williams, Jr.

Demography: R. Avery, P. Chi, J. M. Stycos

Family and sex roles: J. L. Laws, G. F. Streib, J. M. Stycos, N. Tavuchis

Formal and complex organizations: H. Aldrich, G. Gordon, W. F. Whyte, R. M. Williams, Jr.

Mathematical: P. Chi, R. McGinnis

Medical sociology: G. Gordon, M. Goss, G. Reader

Methods and statistics: P. Chi, R. K. Goldsen, D. P. Hayes, R. McGinnis

Political sociology: H. Aldrich, H. Alker, C. Sheingold

Social organization and change: M. Naditch, A. Paris, L. Reissman, B. C. Rosen, C. Sheingold, G. F. Streib, H. Trice, W. F. Whyte, R. M. Williams, Jr.

Social psychology: H. A. Alker, D. P. Hayes, S. Jones, R. E. Kraut, W. W. Lambert, J. L. Laws, L. Meltzer, M. Naditch, D. Regan, B. C. Rosen, G. F. Streib

Stratification and mobility: D. P. Hayes, J. A. Kahl, R. McGinnis, N. Tavuchis

Urban: H. Aldrich, P. Chi, A. Paris, L. Reissman

### Statistics

**Graduate Faculty Representative:** Roger Farrell, White 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 Tests.

Candidates for the Ph.D. degree should consult with the graduate faculty representative regarding the language requirement.

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, W. T. Federer, D. S. Robson, S. R. Searle, D. Solomon, C. L. Wood  
Engineering and operations research applications of probability and statistics: R. E.

Bechhofer, N. U. Prabhu, T. Santner, H. M. Taylor 3d, L. Weiss

Mathematical theory of probability and statistics: R. Farrell, K. Ito, 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: K. Ito, 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, 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, C. L. Wood

Ranking and selection procedures: R. E. Bechhofer, T. Santner

Multivariate analysis: I. Blumen, I. Francis  
Nonparametric statistics: I. Blumen, L. Weiss

Queuing and inventory theory: N. U. Prabhu

Sampling theory: P. J. McCarthy, D. S. Robson

Statistical control theory: H. M. Taylor 3d

### Urban Studies

**Graduate Faculty 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 the 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

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  
 C. 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, Ecology and Evolutionary Biology, Entomology, Environmental Quality, Floriculture and Ornamental Horticulture, Food Science and Technology, Genetics, International Agricultural and Rural Development, International Development, Medical Sciences (Graduate School of Medical Sciences), Microbiology, Natural Resources, Neurobiology and Behavior, Nutrition, Physiology, Plant Breeding and Biometry, Plant Pathology, Pomology, Psychology, Statistics, Vegetable Crops, Veterinary Medicine, Zoology**

### Agronomy

**Graduate Faculty Representative:** Robert B. Musgrave, 519 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 production: W. R. Knapp, R. F. Lucey, R. R. Seaney  
 Seed Technology: B. E. Clark,\* A. A. Khan,\* H. A. MacDonald, L. W. Nittler\*  
 Weeds and herbicides: W. B. Duke, D. L. Linscott

#### *Atmospheric Science*

General meteorology: B. E. Dethier, W. W. Knapp, D. A. Paine  
 Climatology and microclimatology: B. E. Dethier  
 Agricultural micrometeorology: E. R. Lemon  
 Physical meteorology: W. W. Knapp, D. A. Paine

#### *Soil Science*

Soil chemistry: J. M. Duxbury, D. L. Grunes  
 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, 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. Drosdoff  
 Forest soils: E. L. Stone, Jr.  
 Organic soils: J. M. Duxbury

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

### Animal Breeding

**Graduate Faculty 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 some 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

**Animal Science**

**Graduate Faculty 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.

Some teaching assistance is required as a part of the training program. 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, 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, 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, S. T. Slack, R. W. Spalding

Horse husbandry: H. F. Hintz

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: S. E. Bloom

Food Science: R. C. Baker

Nutrition: R. E. Austic, M. C. Nesheim, M. L. Scott, R. J. Young

Physiology: A. Bensadoun, A. van Tienhoven

**Biochemistry**

**Graduate Faculty Representative:** Richard E. McCarty, G-22 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 (preferred) or Biology are required.

Ph.D. candidates are required to teach for at least two semesters. The field has no foreign language requirement but a student's Special Committee may require proficiency in a foreign language.

Ph.D. candidates who intend to minor in biochemistry should consult with a member of the field as soon as possible. Although the intermediate biochemistry sequence (including the laboratory course) normally constitutes the coursework requirement for the minor, other courses may be substituted at the discretion of the student's adviser.

**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

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

J. Gibson: growth regulation in photosynthetic prokaryotes

Q. H. Gibson: haemoproteins; flavoproteins; rapid reaction spectrophotometry; 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  
 R. E. MacDonald: ribosome synthesis and structure; regulation of cell growth  
 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  
 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. B. Wilson: biochemical genetics; physical chemistry of enzymes  
 J. F. Woolton: 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

**Graduate Faculty 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 sci-

ences; and a first-year introductory course in calculus or statistics 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 requirements for the degree.

## Botany

**Graduate Faculty Representative:** R. M. Spanswick, 255 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 pre-scriptive examination during the first semester of residence.

## Research Facilities

The field offers 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. Cornell owns many nearby 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,

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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 the Special Committee.

### Faculty and Specializations

- H. P. Banks: paleobotany, especially of the Devonian; anatomy and morphology  
D. M. Bates: biosystematics and evolution of flowering plants; ethnobotany  
B. F. Chabot: plant physiological ecology  
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  
D. C. Elfving: water relations  
E. E. Ewing: physiology of tuberization with emphasis on hormonal control; starch-sugar equilibria in potatoes as related to enzymes and nucleic acid metabolism  
J. W. Ingram, Jr.: systematics of flowering plants with emphasis on anatomical approaches  
A. T. Jagendorf: electron transport, phosphorylation, ion fluxes and gradients in chloroplasts; protein 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: phloem structure and function; 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 cytotaxonomy  
R. H. Whittaker: plant communities

### Communication Arts

(See p. 47.)

## Ecology and Evolutionary Biology

**Graduate Faculty 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, Paleoecology, 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.

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 by Ph.D. candidates during the second semester. In any event, it must be taken before the student can schedule an admission to candidacy examination.

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 with staff members whose interests are most closely related to their own before they apply.

K. Adler: photoreception, orientation, navigation and circadian rhythms of vertebrates

- M. Alexander: microbial ecology  
 J. P. Barlow: biological oceanography, plankton ecology  
 C. O. Berg: bionomics of freshwater invertebrates  
 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  
 B. F. Chabot: plant eco-physiology  
 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  
 C. A. Hall: (aquatic) ecosystems; modeling  
 R. G. Helgesen: quantitative population ecology of insects  
 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  
 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  
 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  
 D. B. Peakall: regulation of biological systems  
 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. H. Whitlock: experimental epidemiology and endemiology  
 R. H. Whittaker: plant communities  
 W. D. Youngs: fishery biology

## Entomology

**Graduate Faculty Representative:** John P. Kramer, 10 Comstock

**Major and Minor Subjects:** Acarology, Apiculture, Aquatic Entomology, Biological Control, General Entomology (minor only), Economic Entomology, Insect Behavior, Insect Biochemistry, Insect Ecology, Insect Morphology, Insect Pathology, Insect Physiology, Insect Taxonomy, Insect Toxicology and Insecticide Chemistry, Medical Entomology

Excellent facilities for laboratory and field studies are available that include the outstanding Comstock Entomological Library and a renowned insect collection. Details on these facilities are available from the graduate faculty representative.

The Field of Entomology requires a prescriptive academic review for doctoral candidates, usually held during the first semester of work. A core curriculum is available from the graduate faculty representative. The minimum requirement for the Ph.D. degree is proficiency in one foreign language.

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

## Faculty and Specializations

- C. O. Berg: aquatic entomology; ecology and systematics of snail-killing flies  
 J. L. Brann, Jr.: economic entomology; fruit crop insects; extension  
 W. L. Brown, Jr.: systematics and evolution; ants  
 E. W. Cupp: medical entomology; bionomics of blood-feeding Diptera  
 J. E. Dewey: economic entomology; pesticide technology; extension  
 G. C. Eickwort: insect morphology; systematics and behavior of wild bees; acarology  
 P. P. Feeny: chemical ecology; herbivorous insects  
 J. G. Franclemont: systematics; Lepidoptera  
 G. G. Gyrisco: economic entomology; ecology of forage crop insects  
 R. G. Helgesen: economic entomology; insect pest management; population ecology

- W. T. Johnson: extension entomology; plant pathology  
 J. P. Kramer: insect pathology; protozoan and fungal diseases  
 R. A. Morse: apiculture; honey bee social behavior  
 A. A. Muka: economic entomology; vegetable and forage crop insects; extension  
 C. E. Palm: economic entomology; insect ecology  
 R. L. Patton: insect physiology; metabolism  
 L. L. Pechuman: Curator; tabanid systematics  
 D. Pimentel: insect ecology; population ecology; genetic feedback  
 E. M. Raffensperger: economic entomology; household insects  
 R. B. Root: insect ecology; organization of terrestrial communities  
 J. L. Saunders: economic entomology; insects on woody ornamentals  
 M. Semel: economic entomology; vegetable crop insects  
 E. H. Smith: Department Chairperson; economic entomology; fruit insects  
 M. J. Tauber: biological control; insect behavior  
 W. M. Tingey: plant resistance to insects; insects on potatoes  
 C. F. Wilkinson: insect toxicology; synergists and detoxification mechanisms  
 R. G. Young: insect biochemistry; metabolism of toxicants

*Faculty at the New York State Agricultural Experiment Station, Geneva*

- W. S. Bowers: insect biochemistry and physiology; insect hormones  
 A. C. Davis: economic entomology; insects on cole crop, sweet corn, and tomatoes  
 C. J. Eckenrode: economic entomology; soil and vegetable crop insects  
 E. H. Glass: Department Head; economic entomology; pome fruit insects  
 R. J. Kuhr: insect toxicology; metabolism of pesticides in plants and animals  
 S. E. Lienk: economic entomology; stone fruit insects  
 W. H. Reissig: economic entomology; insect biology and pest management  
 W. L. Roelofs: organic chemistry; pheromones: isolation, identification, and synthesis  
 G. A. Schaefer: economic entomology; ecology of small fruit insects  
 E. F. Taschenberg: economic entomology; insects in vineyards  
 H. Tashiro: economic entomology; insects of ornamentals and turf  
 K. Trammel: economic entomology; pome fruit insects

*Members of the Field in other departments at Ithaca*

- T. Eisner: insect behavior; insect-plant interactions  
 W. T. Keeton: systematics; evolution; behavior  
 R. D. O'Brien: insecticide chemistry; neuropharmacology

- L. D. Uhler: insect ecology; insects in plant galls

**Floriculture and Ornamental Horticulture**

**Graduate Faculty Representative:** John G. Seeley, 8 Plant Science Building

**Major and Minor Subject:** Floriculture and Ornamental Horticulture

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 must have a good background in biological and agricultural sciences and an interest in floriculture and ornamental plants.

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.

For the M.P.S. (Agriculture) degree, the field requires completion of thirty course hours related to the student's professional interests, successful completion of a problem-solving project, and a minimum grade point average of 2.5.

**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, turfgrass, ornamental horticulture physiology, taxonomy of ornamental plants, and landscape architecture. Studies relating to the physiology, growth and development, propagation, nutrition, production management, 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, education, 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. Controlled environment rooms, greenhouses and outdoor nursery, and turfgrass production areas are also available.

**Faculty and Specializations**

- J. W. Boodley: culture of greenhouse flower crops, especially foliar analysis; soils and nutrition
- R. T. Fox: retail florist shop management: merchandising, layout, and shop efficiency
- G. L. Good: culture of nursery crops, especially nutrition and container production
- C. F. Gortzig: floriculture crop production management; floriculture extension programming
- J. F. Kaufmann: turfgrass management and physiology; weed control
- 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
- 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; 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

Landscape Architecture courses given in the Department of Floriculture and Ornamental Horticulture are taught by M. I. Adelman, R. W. Dwelle, T. Johnson, and P. S. Tresch.

**Food Science and Technology**

**Graduate Faculty Representative:** Robert C. Baker, 100 Rice Hall

**Major and Minor Subjects:** Food Science, General (majors may not minor within the field), Dairy Science, International Food Science, Food Chemistry, Food Microbiology, Food Processing Waste and Water Technology

Candidates for the M.S. degree are required to register for one major within the field and one minor outside the field. Candidates for the Ph.D. degree are required to register for one major within the field and two minors, at least one of which is taken outside the field. There are no course hour requirements for the M.S. or Ph.D. degrees. In addition to the examinations required by the Graduate School, a qualifying examination is required of Ph.D. candidates before the start of their second semester of residence.

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.

The field offers excellent opportunities for graduate study. All coursework is taken on the Ithaca campus, but students may conduct their research at the New York State Agricultural Experiment Station in Geneva as well as on the Ithaca campus.

**Faculty and Specializations**

*Food Science, General*

- T. E. Acree\*, G. D. Armbruster, R. C. Baker, J. B. Bourke\*, M. C. Bourne\*, P. E. Brecht, P. A. Buck, M. M. Devine, T. W. Downes, D. L. Downing\*, D. C. Graham, L. R. Hackler\*, L. F. Hood, W. K. Jordan, J. E. Kinsella, F. V. Kosikowski, R. L. LaBelle\*, C. Y. Lee\*, L. M. Massey, Jr.\*, N. Mondy, M. A. Morrison, J. C. Moyer\*, H. B. Naylor, N. N. Potter, M. A. Rao\*, J. M. Regenstien, J. M. Rivers, W. B. Robinson\*, J. W. Sherbon, W. F. Shipe, M. L. Shuler, D. F. Splittstoesser\*, K. H. Steinkraus\*, G. S. Stoewsand\*, J. R. Stouffer, J. P. Van Buren\*, G. H. Wellington, J. C. White, R. R. Zall

*Dairy Science*

- 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

*International Food Science*

- 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\*, J. R. Stouffer, G. H. Wellington

*Food Chemistry*

- T. E. Acree\*, G. D. Armbruster, J. B. Bourke\*, M. C. Bourne\*, P. E. Brecht, P. A. Buck, L. R. Hackler\*, E. E. Hester, L. F. Hood, G. Hrazdina\*, J. E. Kinsella, C. Y. Lee\*, B. A. Lewis, D. J. Lisk, L. M. Massey, Jr., L. R. Mattick\*, N. Mondy, M. A. Morrison, M. A. Rao\*, J. M. Regenstien, J. M. Rivers, W. B. Robinson\*, R. S. Shallenberger\*, J. W. Sherbon, W. F. Shipe, G. S. Stoewsand\*, J. P. Van Buren\*, R. H. Walter\*, G. H. Wellington

*Food Microbiology*

- P. A. Buck, N. C. Dondero, D. C. Graham, F. V. Kosikowski, R. A. Ledford, H. B. Naylor, N. N. Potter, D. F. Splittstoesser\*, J. R. Stamer\*, K. H. Steinkraus\*, J. C. White

- Food Processing Waste and Water Technology*  
N. C. Dondero, M. L. Shuler, 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.)

**Graduate Faculty 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 strongly recommended for doctoral candidates; any particular requirements are established by the student's Special Committee.

Shortly after the formation of the Special Committee, it meets with the student in order to examine the student's past training and research interests and to recommend a course of study.

All students in the field must 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. Students should choose professors whose interests coincide with their own.

### Faculty

A. Blackler, S. E. Bloom, 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

## International Agricultural and Rural Development

(See p. 57.)

## International Development

(See p. 58.)

## 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. 19 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. 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

The opportunity for 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 at the Sloan-Kettering Division of the Graduate School of Medical Sciences. 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 systems, 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

**Graduate Faculty Representative:** H. B. Naylor, 413 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 virology, genetics, physiology, biochemistry, molecular biology, systematic and environmental microbiology, and microbial ecology.

### Faculty and Specializations

Animal virology: L. E. Carmichael, J. H. Gillespie  
Aquatic microbiology: M. Alexander, N. C.

Dondero, H. W. Seeley, Jr.

Bacterial photosynthesis: J. Gibson

Bacterial virology: H. B. Naylor

Food microbiology: H. B. Naylor, D. F.

Splittstoesser\*, J. R. Stamer\*, K. H.

Steinkraus\*

Industrial fermentations and bioengineering:

R. K. Finn, K. H. Steinkraus\*

Metabolic control: J. Gibson, P. J. VanDemark,

S. A. Zahler

Microbial ecology: M. Alexander, E. A. Delwiche,

J. Gibson, R. E. MacDonald, H. W. Seeley, Jr.,

T. Weaver

Microbial genetics: S. A. Zahler

Microbial nutrition: P. J. VanDemark

Microbial physiology: E. A. Delwiche, J. Gibson,

H. W. Seeley, Jr., P. J. VanDemark, T. Weaver

Microbiology of wastes: N. C. Dondero

Molecular biology: R. E. MacDonald

Soil microbiology: M. Alexander

\* Faculty of the New York State Experiment Station at Geneva.

### Natural Resources

**Graduate Faculty Representative:** Ray T. Oglesby, 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 physical sciences and a working knowledge of statistical methods are highly desirable. To major in Natural Resources Conservation, a student should have previous training in a scientific discipline which can be used in an integrative way in focusing on natural resources problems; professional job experience is desirable.

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

### Research Facilities

A variety of terrestrial and aquatic environments is available for research. Within sixty miles of the campus are reforested areas, mature hard-

wood forests, extensive agricultural lands, wetlands, lakes, streams, and ponds.

Several forested or partially wooded areas are available for research, demonstration, and management purposes. Cornell's Arnot Teaching and Research Forest, eighteen miles from the campus, consists of 4,000 acres of second growth beech, birch, maple, hemlock, and associated native forest trees. The forest has populations of grouse, deer, and other wildlife, and contains ten ponds. Studies of plantation management and tree growth requirements have been conducted at the Arnot Forest for many years.

The Department of Natural Resources operates the Cornell University Biological Field Station, with 1½ miles of shoreline and 400 acres of land at Shackelton Point on Oneida Lake, a shallow eighty-square mile eutrophic lake with about sixty warm water fish species. The Cornell Biological Field Station has a permanent research and maintenance staff. Facilities are available for short-term housing and research.

A Fishery Laboratory, located a half mile from the campus, contains extensive facilities for instruction and research in fishery and aquatic science. The laboratory includes wet labs, an aquarium room and facilities for processing and holding fish, a radiation laboratory, and a workshop. There are ten ponds on the laboratory grounds for research on warm water fishes in semi-natural conditions. A section of Cascadilla Creek, which flows through the Fishery Laboratory grounds and the Cornell campus, is used for experimental studies in trout management. A fully equipped, forty foot research vessel and several smaller boats are available for use in aquatic ecology and fishery studies on Cayuga Lake.

Certain wildlife research facilities are located one mile from the campus at the Ithaca Game Farm of the New York State Department of Environmental Conservation. The Bio-Thermal Laboratory houses two thermal environment simulation tunnels, laboratory facilities for physiology, telemetry equipment, and equipment for nutritional analyses. Upland game birds are readily available for research at this facility. Several mouseproof enclosures for small mammal ecology and population studies are also located at the Game Farm.

The Resource Information Laboratory is located on the main campus and provides facilities for a variety of research concerning land use, resource inventories, and applications of remote sensing. The laboratory maintains a library of aerial photographs of the State of New York, supervises the service unit of the New York Land Use and Natural Resource Inventory, and has complete coverage of the ERTS-A and Skylab imagery of New York State and neighboring areas. Equipment and photographic processing facilities for use in interpreting

remote sensing data are available for graduate research programs.

In addition, there are other nearby areas that the administering agencies have generously made available for special research, graduate study, and class demonstration. The 12,000-acre Connecticut Hill Game Management Area of the New York State Department of Environmental Conservation, twelve miles from Ithaca, is an outstanding grouse, deer, and woodcock area. A 3,200-acre state refuge at Howland's Island has been managed for waterfowl and other game since 1931; it is a useful study and demonstration area forty-five miles from the campus. The Montezuma National Wildlife Refuge of the U.S. Fish and Wildlife Service, forty miles away, is an outstanding waterfowl and muskrat management area.

### Cooperative Research

The New York Cooperative Wildlife Research Unit is supported jointly by Cornell University, the New York State Department of Environmental Conservation, the United States Fish and Wildlife Service, and the Wildlife Management Institute. Its primary missions are to train graduate students in wildlife management and to conduct basic and applied research. This unit employs two full-time biologists. Current research projects are concerned with (1) ecology of wetlands, (2) small mammal population dynamics, (3) effects of fire on secondary succession, (4) mammalian reproduction, and (5) use of telemetry to study predation on waterfowl.

The New York Cooperative Fishery Unit was established at Cornell in 1963 to combine federal, state, and University assets to increase the facilities for advanced training and research in fishery biology. This unit employs two professors. Current research projects are directed primarily toward laboratory and pond experiments to define and quantify sources of natural mortality in the early life stages of the largemouth bass and other warm water fish. New studies are being initiated to determine the needs and the methods for providing recreational fishing in small city and suburban areas. The unit's assistant leader serves as Director of the Cornell Aquaculture Program, a comprehensive program concerned not only with traditional methods of fish culture, but also methods and facilities for culturing additional species, disease problems, processing and marketing, water quality and effluent problems, fish genetics and the nutrition of fishes. Intensive and extensive methods of producing a variety of aquatic plants and animals are under investigation.

### Faculty and Specializations

H. B. Brumsted: community and regional resource problems; wildlife planning, policy

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- T. J. Cade: environmental biology of vertebrates  
J. W. Caslick: wildlife management; biology of game birds and small mammals; wildlife-agriculture relationships  
A. Dickson: social economics of forestry; conservation communications  
A. W. Eipper: population ecology of young fish; fishery resource management  
W. H. Everhart: freshwater fisheries; environmental impact statements  
J. L. Forney: ecology of freshwater fish  
L. S. Hamilton: environmental resource analysis; multiple use of forest lands; land use planning  
E. E. Hardy: remote sensing and resource inventories  
J. W. Kelley: environmental conservation education; youth development programs in natural resources  
R. J. McNeil: international resource problems  
A. N. Moen: physiology, nutrition, and behavior of free-ranging animals  
R. R. Morrow: forest management, economics and society  
J. G. Nickum: aquaculture; warm water fishery management  
R. T. Oglesby: aquatic ecology; comparative limnology; water quality management  
G. R. Reetz: outdoor recreation, water resources  
M. E. Richmond: reproduction and population biology of mammals and birds  
C. L. Schofield: aquatic chemistry, aquatic productivity; population energetics  
D. Q. Thompson: wetland and waterfowl ecology; upland habitat management; small mammal population dynamics  
D. A. Webster: ecology and population dynamics of trout and salmon  
B. T. Wilkins: outdoor recreation and natural resource policies  
W. D. Youngs: biometrics and modeling aquatic systems

### Neurobiology and Behavior

(See also the listing under Medical Science.)

**Graduate Faculty 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 or her Special Committee during the first semester of study and to acquire teaching experiences while at Cornell.

### Faculty and Specializations

- Members of the faculty will be especially interested in directing research in the areas mentioned below. 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 and circadian rhythms of vertebrates; behavior of amphibians and reptiles  
K. Arms: embryology of nerve and muscle; ontogeny of behavior  
R. Buskirk: social behavior, field studies  
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  
B. Halpern: sensory physiology; chemoreception  
H. C. Howland: sensory physiology; mathematical biology  
R. R. Hoy: animal communication; behavior genetics of invertebrates; regeneration and development in invertebrate nervous systems  
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  
W. Roelofs: insect sex pheromones; identification and behavioral responses in the field and in the laboratory  
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

**Graduate Faculty Representative:** Willard J. Visek, 438 Morrison Hall

**Major and Minor Subjects:** Animal Nutrition, Human Nutrition, General Nutrition, Foods, International Nutrition, Nutritional Biochemistry, Food Service Systems (M.S. only)

Adequate background in chemistry, biology, physics, and mathematics is essential for advanced study in nutrition, particularly in areas involving laboratory experimentation. Some additional training in nutrition, food science, and microbiology is recommended. For areas of study relating to community aspects of nutrition, course experience in the social sciences is important. Entering students with background deficiencies can correct a limited number after they have been admitted to the graduate program.

Candidates for the M.S. degree must satisfy requirements in one major and one minor subject area. Candidates for the Ph.D. degree must satisfy requirements in one major and two minor subject areas; only one of the minor subjects may be selected from within the field. The specific requirements are determined by the Special Committee for each candidate.

Members of the faculty in various colleges and divisions of the University with interests in nutrition comprise the graduate faculty in the field. Graduate students may study with faculty in the Division of Nutritional Sciences, the College of Veterinary Medicine, the Departments of Animal Science or Poultry Science in the College of Agriculture and Life Sciences, or the Department of Food Science and Technology of the Geneva Experiment Station.

## Research and Study Opportunities

Depending upon interests, a student may obtain training in many aspects of nutrition and in the biological and social sciences related to nutrition. Several combinations of majors and minors selected from all colleges or divisions of the University are possible, and both human and animal nutrition interests are accommodated within the field. For those preparing themselves for laboratory experimentation in nutrition, physiology and biochemistry minors are usually recommended although other minors are frequently chosen. Students interested in community and international nutrition have access to active programs which provide opportunity for field experience in the United States or abroad. Students seeking training in foods have opportunity to apply principles and techniques

of organic chemistry, biological science, and microbiology to problems dealing with human food.

## Faculty and Specializations

Research of the faculty encompasses many aspects of nutrition: metabolism of proteins and amino acids, vitamins, minerals, lipids, energy metabolism, gastrointestinal physiology, nutritional pathology, nutrition and behavior, community nutrition, international nutrition, food habits, dietetics, and nutrition education. Research is conducted with man, lower animals, and microorganisms as experimental models. Faculty of the field have ongoing research programs relating nutrition to man, as well as to laboratory animals, companion animals, and food producing animals. Faculty members grouped by general categories of their major interests are on the list which follows:

Clinical and human nutrition studies: R. H. Barnes, J. Bowering, K. Clancy-Hepburn, M. Devine, M. C. Latham, M. A. Morrison, J. M. Rivers, D. A. Roe, R. Schwartz, W. J. Visek, K. Visneyi

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, D. B. McCormick, M. A. Morrison, 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, D. Zilversmit

Ruminant nutrition studies with beef cattle, dairy cattle, sheep, goats: C. E. Coppock, J. M. Elliot, D. E. Hogue, L. Krook, F. W. Lengemann, W. G. Merrill, J. T. Reid, S. E. Smith, P. J. Van Soest, R. G. Warner  
Foods: G. Armbruster, L. R. Hackler, E. E. Hester, B. Lewis, N. Mondy

## Physiology

(See also the listing under Medical Sciences.)

**Graduate Faculty Representative:** Ari van Tienhoven, Rice 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 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.

All students admitted to the Ph.D. program in this field must take a written examination as part of the admission to candidacy examination. All students minoring in physiology must take a comparable examination. The written examination will be given twice a year: once in the fall and once in the spring.

Each Ph.D. student will be required to present a seminar, open to the faculty and graduate students of the field, on the thesis work after all laboratory work is essentially complete but before the written thesis is in final form.

A doctoral candidate in physiology must have two minor subjects. At least one of the minor committee members must not be a member of the Field of Physiology.

#### Faculty and Specializations

Prospective students are urged to correspond with professors in the list below whose interests are nearest their own.

Behavioral physiology: P. W. Gilbert, H. C. Howland

Biochemistry, membrane structure: W. J. Arion, 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

Endocrinology: W. Hansel, A. van Tienhoven

Environmental physiology: J. W. Hudson

Enzymology: J. F. Woolton

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, W. A. Wimsatt

Lactation: F. W. Lengemann

Lipid transport and metabolism: A. Bensadoun, D. B. Silversmit

Metabolism: E. N. Bergman, T. R. Houpt, F. W. Lengemann, W. J. Visek

Neurophysiology: E. L. Gasteiger, P. W. Gilbert, 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, F. W. Lengemann, R. H. Wasserman

Reproduction: A. P. Casarett, R. H. Foote, P. W.

Gilbert, W. Hansel, N. L. Van Demark, 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, A. F. Sellers, W. A. Wimsatt

## Plant Breeding and Biometry

**Graduate Faculty 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 crop plants with which they are primarily concerned. Staff listed under biometry direct theses on various aspects of statistical and mathematical genetics.

#### Biometry

- F. B. Cady: response surface designs, estimation and statistical analyses  
 W. T. Federer: statistics and experimental design  
 T. D. Mount: economic statistics  
 D. S. Robson: statistics and biometrical genetics  
 S. R. Searle: statistics and computing  
 D. L. Solomon: statistics and biomathematics  
 C. L. Wood: statistics and biomathematics

#### Plant Breeding

- R. E. Anderson: golden nematode resistance in potatoes  
 L. V. Crowder: international agriculture; soybeans  
 V. E. Gracen: genetics and biochemistry of insect and disease resistance  
 C. O. Grogan: corn  
 N. F. Jensen: small grains  
 C. C. Lowe: forage crops  
 H. M. Munger: vegetable crops  
 R. P. Murphy: forage crops  
 W. D. Pardee: extension and pure seed programs  
 R. L. Plaisted: potatoes  
 D. H. Wallace: vegetable crops

#### At the New York State Agricultural Experiment Station in Geneva

- D. W. Barton, M. H. Dickson, R. C. Lamb,  
 G. A. Marx, D. K. Ourecky, R. W. Robinson,  
 R. D. Way

### Plant Pathology

**Graduate Faculty 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 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, disease cytology, 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 graduate faculty representative.

### Faculty and Specializations

- G. S. Abawi:\* research; soil-borne pathogens, vegetable diseases, disease control  
 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 re-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
- J. E. Hunter:\* research; epidemiology, vegetable diseases
- H. W. Israel: research and teaching, cytology of disease 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
- P. E. Nelson: research, diseases of ornamental crops, pathological histology
- W. F. Rochow: research, virus diseases of cereal crops, aphid transmission 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
- J. K. Uyemoto:\* 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
- H. J. Wilson: research, cytology
- O. C. Yoder: research, postharvest diseases, physiology of disease
- M. Zaitlin: teaching, plant virology; research, virus synthesis, physiology of virus infections

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

## Pomology

**Graduate Faculty Representative:** Loyd E. Powell, Jr., 121 Plant Science Building

**Major and Minor Subject:** Pomology

Applicants to this field need not have done their undergraduate work in horticulture, but they

should have a sound background in the basic sciences and an interest in fruit plants. A knowledge of botanical and chemical subjects is particularly helpful. During their graduate work students are expected to become well acquainted with the Field of Pomology and with other fields closely allied to their thesis problems. Students registered in the 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, postharvest physiology, mineral nutrition, cold hardiness, rest period, root initiation, rootstocks, fruit set and development, fruit breeding, plant pigments, plant water relations, photosynthesis, 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
- F. W. Liu: postharvest physiology; tropical and subtropical fruits
- 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
- J. P. Tompkins: small fruits; grapes

### At Geneva

- J. N. Cummins: rootstock breeding, propagation and testing; high density systems; rooting studies
- O. F. Curtis, Jr.: weed control; juvenility; apple fruit growth
- 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
- A. N. Lakso: orchard management, mechanical harvesting and pruning; environmental physiology
- 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

- R. M. Pool: grape breeding; vine physiology  
 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

## Psychology

**Graduate Faculty Representative:** Leo Meltzer, 234 Uris Hall

**Major and Minor Subjects:** Comparative Psychology, Developmental Psychology, Differential Psychology and Psychological Tests, Experimental Psychology, Experimental Psychopathology, Mathematical Psychology, Personality and Social Psychology, Physiological Psychology, Psycholinguistics

**Minor Subjects:** General Psychology, History and Systems of 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 other subjects, especially mathematics and natural sciences, as well as in psychology. Candidates for a terminal master's degree are not accepted.

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 a week of supervised teaching experience for two semesters, and a one-year course in statistics and experimental design.

Each student will draw up a proposal of intended 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 graduate faculty representative. A fourth member of the Special Committee, appointed by the graduate faculty representative, has greater responsibility than the other committee members for insuring that the student has adequate breadth.

During the second semester in residence, each student will submit to the Special Committee a report detailing the academic work and research carried out during the year, as well as plans for the future. The student will then arrange a Special Committee meeting to discuss the report.

At an appropriate time, each student will submit to the 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 graduate faculty representative.

A fellowship specifically for students in this field is The John Wallace Dallenbach Fellowship in Experimental Psychology.

New students in this field may be requested to arrive one week before the beginning of classes for an orientation program.

Research is conducted at the following:

- (1) Uris Hall which has special rooms for research in problems of perception and cognition; a social psychology laboratory equipped for experimental or observational studies of transitory or enduring groups; electrophysiological, histological, and chemical laboratories; major and minor surgery facilities, and facilities for research with laboratory animals; dark rooms, shops, and laboratory computers with the capacity to control equipment in experiments.
- (2) the Howard S. Liddell Laboratory of Comparative and Physiological Psychology which includes facilities for research with large 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) the Cornell Medical Centers in New York City and in White Plains, N. Y., which provide facilities for the study of chronic or acute brain disease
- (5) a mobile laboratory for the study of children near their schools
- (6) 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 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, A. W. Boykin, U. Bronfenbrenner, H. Feldman, E. J. Gibson, H. Ginsberg, 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:

A. W. Boykin, 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, R. D. Mack

#### *History and Systems of Psychology*

H. A. Alker, A. W. Boykin, J. Catlin, 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, cognitive consistency theory, interpersonal evaluations, guilt and persuasion, attitude change, cross-cultural studies of socialization, self-concept, conflict resolution, time perspective: H. A. Alker, U. Bronfenbrenner, J. Condry, H. Feldman, L. W. Gruenfeld, J. S. Harding, D. P. Hayes, D. E. Hedlund, S. C. Jones, R. E. Kraut, 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

(See p. 63.)

## Vegetable Crops

**Graduate Faculty Representative:** Peter Minotti, 162 Plant Science Building

#### **Major and Minor Subjects:** Vegetable Crops

The field offers graduate training leading to the Master of Professional Studies (Agriculture), Master of Science, and Doctor of Philosophy degrees. Students who wish to obtain a Ph.D. degree are usually expected to obtain a master's degree first.

A good background in biological and agricultural sciences, together with an interest in economic plants is desirable, and farm experience is an advantage.

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.

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.

### 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 and genetics
- R. D. Sweet: chemical and biological weed control
- P. E. Brecht: postharvest physiology; biological aspects of handling and marketing vegetables
- R. Sheldrake: greenhouse crops; structures, systems; soil management, and nutrition
- L. D. Topoleski: vegetable crops extension (preadult); pollen physiology and interspecific 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: nutrition and physiology of crops and weeds
- S. L. Dallyn: vegetable production practices on organic soils
- E. E. Ewing: potatoes, especially the inter-relationships 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

**Graduate Faculty Representative:** A. J. Winter, 225 Research Tower, Veterinary College

**Major and Minor Subjects:** Animal Physiology, Immunology, Parasitology, Physical Biology (including Radiation Biology), Theriogenology, Veterinary Anatomy, Veterinary Bacteriology, Veterinary Medicine, Veterinary Pathology, Veterinary Pharmacology, Veterinary Surgery, Veterinary Virology

Applicants from countries other than the United States or Canada are requested to submit results of the Graduate Record Examinations Aptitude Test if feasible; otherwise, they may submit 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.

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 57,000

volumes and 1,000 current serials. 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 nearby. These include the virus disease laboratories, poultry disease facilities, and sheep and cattle disease farms.

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

#### *Animal Physiology*

- Absorption and blood flow in the gastrointestinal tract, particularly the ruminant forestomach: A. Dobson
- Biochemical characterization of cartilage and pathogenesis of degenerative disease in hip joints of developing dogs: G. Lust
- Comparative gastroenterology; gastric and large intestine secretory and absorptive functions: C. E. Stevens
- Comparative physiology of food intake control; urea metabolism in herbivores: T. R. Houpt
- Enzymology of intermediate metabolism with emphasis on membrane associated functions: W. J. Arion
- Enzymology of protein digestion with emphasis on structural functional relationships: J. F. Wootton
- Experimental surgery; hormone bioassay: L. L. Nangeroni
- Metabolism and nutrition: F. W. Lengemann
- Mineral metabolism: F. A. Kallfelz
- Mineral metabolism, intestinal absorption mechanisms, membrane transport: R. H. Wasserman
- Neurophysiology: sensory and central integrative processes: D. N. Tapper
- Neurophysiology: vertebrate central nervous system, nerve nets: E. L. Gasteiger
- Regulation of forestomach function: A. F. Sellers
- Ruminant metabolism with emphasis on the entire animal, liver, digestive tract and kidneys: E. N. Bergman
- #### *Immunology*
- Immunochemical studies of bacterial and viral antigens: J. R. Duncan, N. L. Norcross, R. D. Schultz, A. J. Winter
- Ontogenetic studies of the immune response; neonatal immunity: S. G. Campbell, R. D. Schultz

- Quantitative and qualitative studies of cellular and humoral immune responses in normal and pathological states: J. R. Duncan, N. L. Norcross, R. D. Schultz
- Secretory immunity, particularly of the reproductive tract and the mammary gland: J. R. Duncan, N. L. Norcross, A. J. Winter
- Parasitology*
- Diagnosis and treatment of parasitic diseases of domestic animals: J. R. Georgi, J. H. Whitlock
- Quantitative interactions of host and parasite systems with the environment: J. R. Georgi, J. H. Whitlock
- Taxonomy, bionomics, and comparative anatomy and physiology of helminths: J. R. Georgi, J. H. Whitlock
- Physical Biology (including Radiation Biology)*
- Biological effects of radiation: A. P. Casarett
- Environmental contamination; veterinary statistics: J. C. Thompson, Jr.
- Fission product metabolism in domestic animals: F. W. Lengemann
- Veterinary nuclear medicine: F. A. Kallfelz
- Theriogenology (Animal Reproduction)*
- Andrology and gynecology: I. Settergren
- Reproductive pathology: J. R. Duncan, K. McEntee
- Veterinary Anatomy*
- Applied anatomy of domestic mammals: R. E. Habel
- Comparative neurology: J. F. Cummings, A. de Lahunta
- 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
- Mammalian embryology, teratology, and development: H. E. Evans, W. O. Sack
- Veterinary Bacteriology*
- Anaerobic infections: S. G. Campbell
- Canine brucellosis: diagnosis, pathogenesis, and control: L. E. Carmichael
- Comparative aspects of mycobacterial infections: J. R. Duncan
- Erysipelas arthritis in swine: J. F. Timoney
- Infections of fin-fish, shellfish, and water fowl: L. Leibovitz, J. F. Timoney
- Mycoplasma: culture, classification, and pathogenicity: J. Fabricant
- Salmonellosis: pathogenesis, virulence factors and epidemiology: R. F. Kahrs, J. F. Timoney
- Streptococcal and staphylococcal diseases: N. L. Norcross, R. D. Schultz
- Vibriosis and other infections of the bovine reproductive tract: J. R. Duncan, A. J. Winter
- Veterinary Medicine*
- Biomechanics: H. F. Schryver
- Clinical nutrition and metabolic disease: H. F. Hintz, F. A. Kallfelz, H. F. Schryver, B. E. Sheffy
- Comparative gastroenterology: F. A. Kallfelz, B. C. Tennant, R. H. Whitlock
- Comparative neurology: J. F. Cummings, A. de Lahunta
- Comparative ophthalmology: S. I. Bistner
- Dermatology: R. W. Kirk
- Epidemiology and preventive medicine: N. B. Haynes, R. F. Kahrs
- Internal medicine: F. H. Fox, R. W. Kirk, B. C. Tennant, R. H. Whitlock
- Laboratory medicine (hematology, clinical chemistry, and clinical microbiology): J. Bentinck-Smith, J. B. Tasker
- Radiology and nuclear medicine: J. C. Geary, F. A. Kallfelz, W. J. Roenigk
- Veterinary Pathology*
- Clinical pathology (hematology, clinical chemistry, and clinical microbiology): J. Bentinck-Smith, J. B. Tasker
- Diagnostic pathology: J. M. King
- Diseases of laboratory animals, fish and amphibia: C. I. Boyer, Jr.
- Oncology, including tumor pathogenesis, virology and immunology: K. M. Lee, F. Noronha, J. E. Post, C. G. Rickard
- Pathology of nutritional diseases: L. P. Krook
- Reproductive pathology: J. R. Duncan, K. McEntee
- Ultrastructural pathology: J. N. Shively
- Veterinary Pharmacology*
- Thyroid hormone and brain chemistry, particularly in the developing brain: W. S. Schwark
- Toxicity of chelating agents with emphasis on the pathogenesis of toxicity: A. L. Aronson
- Veterinary Surgery*
- General surgery: D. D. Delahanty, R. E. Hoffer
- Orthopedic surgery: D. D. Delahanty, R. Dueland
- Veterinary Virology*
- Aquatic viral diseases: M. Appel, J. A. Baker, C. Boyer, J. H. Gillespie, J. King, L. Leibovitz
- Avian viral diseases, respiratory and oncogenic; diagnostic methods: B. W. Calnek, J. Fabricant, S. B. Hitchner, M. Peckham
- Bovine viral diseases: etiology, pathogenesis, epidemiology, and host response: R. Kahrs, R. D. Schultz, F. Scott, B. Sheffy
- Canine viral diseases: etiology, pathogenesis, epidemiology and host response: M. J. Appel, J. A. Baker, L. E. Carmichael, G. Lust, R. D. Schultz, B. E. Sheffy
- Effects of nutrition on host response to selected canine viruses: B. E. Sheffy
- Equine viral diseases: etiology, pathogenesis, epidemiology and host response: L. Coggins
- Etiologic and epidemiologic studies of bovine winter dysentery: S. G. Campbell, R. F. Kahrs, F. W. Scott, C. E. Stevens, B. C. Tennant
- Feline urolithiasis: J. H. Gillespie, L. P. Krook
- Feline viral diseases: etiology, pathogenesis, epidemiology and host response: J. H. Gillespie, K. M. Lee, F. W. Scott

Principles and procedures for epidemiologic investigation of animal disease outbreaks:

R. F. Kahrs

Tumor viruses: immunology, virology and pathology: K. M. Lee, F. M. Noronha, J. Post, C. G. Rickard

## Zoology

**Graduate Faculty 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, 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

K Arms: developmental biology; developmental neurobiology

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

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

**Graduate Faculty Representative:** S. F. Shen, 206 Upson 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 midyear, except in unusual cases.

Candidates must learn French, German, Russian, or English in addition to their native language to satisfy the language requirement for the Ph.D. degree.

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 degree.

In this field emphasis is placed on basic

aerospace sciences to prepare the students to cope with the characteristic diversity in research frontiers and industrial development. The faculty is particularly strong and active in fluid mechanics in its broadest definition. Current research includes various fundamental studies in fluid dynamics and aerodynamics such as noise generation, transonic flows, unsteady flows, and numerical methods. There is also a program developing a nonpolluting automobile engine, and research in chemical kinetics, plasma dynamics, and structural mechanics.

### 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; kinetics of pollution
- P. L. Auer, D. L. Turcotte: magnetohydrodynamics; continuum plasma physics
- G. S. 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
- A. R. George: noise generation by aerodynamic sources
- R. H. Gallagher: structures and materials
- D. L. Turcotte: geological fluid flows
- E. L. Resler, Jr.: ferromagnetics
- R. H. Gallagher, S. F. Shen: finite-element methods

## Agricultural Engineering

**Graduate Faculty Representative:** J. Robert Cooke, 228 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 students who plan to enter engineering practice. This program is intended to develop students' backgrounds in engineering design as well as strengthen their 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 do not intend to become involved in design and research. Each M.P.S.(Agr.) degree applicant must submit scores of either the Graduate Record Examinations or the Miller Analogies Test. For further information, see the *Announcement of the College of Agriculture and Life Sciences*.

An applicant to the Ph.D., M.S., or Master of Engineering programs 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 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 graduate faculty representative.

#### *Agricultural Engineering*

All graduate faculty members: bioengineering; engineering properties of biological materials; materials handling; and all other subject areas listed below.

E. W. Foss, L. H. Irwin, F. G. Lechner: agricultural mechanization and mechanization teaching; safety engineering; community and resource development

#### *Agricultural Structures*

L. D. Albright, 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, W. J. Jewell, R. C. Loehr, D. C. Ludington: agroecosystems analysis; animal and food processing waste management; identification and control of air and water pollution from agricultural activities; land disposal of wastes; rural environmental engineering

#### *Electric Power and Processing*

R. B. Furry, R. W. Guest, D. R. Price, G. E. Rehkugler, N. R. Scott, E. S. Shepardson: electrical and electronic control systems; processing of agricultural materials; application of electromagnetic radiation to agriculture; systems modeling and analysis; energy utilization and conservation

#### *Power and Machinery*

J. R. Cooke, R. W. Guest, W. W. Gunkel, E. D. Markwardt, W. F. Millier, R. H. Rand, G. E. Rehkugler, E. S. Shepardson: agricultural machinery design and development; crop harvesting, handling and processing systems; machinery management, seed pellet-

ing, safety and human factors, biomechanics, 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, L. H. Irwin, G. Levine: surface water hydrology, drainage; irrigation; soil-plant-water relationships; hydraulics; erosion control; tropical water management; and secondary road systems

## Applied Mathematics

**Graduate Faculty Representative:** James H. Bramble, 301 White Hall

**Major Subject:** Applied Mathematics

The graduate program in Applied Mathematics is based on a solid foundation in pure mathematics which includes the fundamentals of algebra and analysis. It involves a grounding in the methods of applied mathematics and studies of areas in which significant applications of mathematics are made. The field has a broadly based interdepartmental faculty which can direct student programs in a large number of areas of the mathematical sciences.

Many rather specialized or interdisciplinary programs can be designed for the individual student, including, for example, a variety of possibilities in biomathematics.

The program is open to applicants from various undergraduate backgrounds which contain a substantial mathematical component. Applicants interested in Applied Mathematics may also wish to investigate some of the other Cornell programs offered in the Fields of Computer Science, Mathematics, Operations Research, Statistics, Theoretical and Applied Mechanics, as well as various other fields in the physical sciences and engineering.

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

The thesis is normally a mathematical contribution toward the solution of a problem arising outside mathematics.

### Faculty and Specializations

T. Berger: information theory; statistical communication; random processes  
L. J. Billera: game theory; combinatorics; mathematical economics  
H. D. Block: biomathematics; artificial intelligence; robots; environmental systems  
J. H. Bramble: numerical analysis; partial differential equations  
H. J. Carlin: microwave and network techniques  
R. L. Constable: theory of computing; automata; logic

J. E. Dennis: numerical mathematics; mathematical programming  
J. C. Dunn: optimal control theory; pattern classification  
R. Farrell: mathematical statistics  
T. L. Fine: decision theory; comparative probability; speech recognition  
M. E. Fisher: foundation and applications of statistical mechanics; combinatorics  
W. H. J. Fuchs: mathematical methods of physics  
D. R. Fulkerson: networks; mathematical programming; combinatorics  
L. Gross: analysis; mathematics of quantum theory  
J. T. Jenkins: nonlinear field theories in mechanics; continuum mechanics  
H. Kesten: probability theory  
J. C. Kiefer: probability and statistics  
J. A. Krumhansl: solid state physics; microscopic description of macroscopic properties of materials  
S. Leibovich: fluid dynamics; magnetohydrodynamics  
S. Levin: mathematical biology; differential equations  
R. L. Liboff: kinetic theory; plasma physics; electrodynamics; quantum mechanics  
W. F. Lucas: game theory; combinatorics  
G. S. S. Ludford: fluid mechanics; magneto-fluid dynamics  
M. K. Majumdar: mathematical economics  
J. J. Moré: numerical analysis  
A. Nerode: logic; recursive functions and computability; automata  
L. E. Payne: partial differential equations  
N. U. Prabhu: stochastic processes; queues and inventories  
R. H. Rand: differential equations; dynamical systems; biomechanics  
S. Robinow: blood flow; cell proliferation  
E. E. Salpeter: theoretical astrophysics; nuclear theory; statistical mechanics  
A. H. Schatz: partial differential equations  
A. R. Seebass: aerodynamics; fluid dynamics  
S. F. Shen: aerodynamics; rarefied gasdynamics  
F. L. Spitzer: probability theory and analysis  
B. Widom: physical chemistry; statistical mechanics

## Applied Physics

**Graduate Faculty Representative:** Terrill A. Cool, 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 physics and materials science, space physics, and surface physics. Additional details about current programs are given in brochures obtainable from the graduate faculty representative.

Students in Applied Physics usually receive some sort of financial aid during their entire graduate study program, including summers. 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 students the opportunity to master advanced topics in physics and extend their skills in their 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, K. B. Cady, 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, J. R. Houck, B. L. Isacks, H. H. Johnson, V. O. Kostroun, 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

**Graduate Faculty Representative:** Yervant Terzian, 428 Space Sciences Building

**Major and Minor Subjects:** Astronomy, Astrophysics, Magnetohydrodynamics, Planetary

Studies, Radiophysics, Space Sciences (General)

Students admitted to this field must have a strong background in electrical engineering, engineering physics, mathematics, or, especially, physics. The Graduate Record Examinations, including the Advanced Test in Physics, are required and often are of great help in admitting outstanding students from less well-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. 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 or at other major radio observatories.

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 14853.

### Faculty

R. Bolgiano, J. A. Burns, F. D. Drake, D. T. Farley, P. Gierasch, T. Gold, K. I. Greisen, M. O. Harwit, J. R. Houck, R. L. Liboff, R. V. E. Lovelace, G. H. Morrison, J. M. Rankin, E. L. Resler, C. Sagan, E. E. Salpeter, R. N. Sudan, Y. Terzian, S. A. Teukolsky, J. Veverka

### Atmospheric Science

(Please see Field of Agronomy on p. 64.)

### Chemical Engineering

**Graduate Faculty Representative:** Peter Harriott, 101 Olin Hall

**Major and Minor Subjects:** Biochemical Engineering, Chemical Engineering (General), Chemical Microscopy, Chemical Processes and Process Control, Materials Engineering, Kinetics and Transport Processes

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. These may involve either ex-

perimental 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: membrane transport; biophysical transport; interfacial phenomena
- J. R. Anderson: surface chemistry; catalysis
- K. B. Bischoff: medical and microbiological engineering; chemical reaction engineering
- G. G. Cocks: light and electron microscopy; structure and properties of materials (particularly gels and biomaterials); crystallography
- R. K. Finn: fermentation kinetics; agitation and aeration; microbial polysaccharides; chemical waste treatment
- 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
- M. L. Shuler: food production; microbial biogeochemistry; insolubilized enzymes; microbial growth and interaction
- J. C. Smith: heat transfer; mixing; mechanical separations
- J. F. Stevenson: transport phenomena; polymer rheology; medical applications of chemical engineering
- 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; saline-water conversion
- 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

**Graduate Faculty 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 the 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. Graduate students will ordinarily pursue these objectives by taking advanced courses, by participation in organized and informal seminars and discussions with their associates and faculty members, and by carrying out and reporting on research projects in their major subjects.

Graduate students normally carry on research during the summer, and receive financial support for this purpose.

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 chairperson 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. A proficiency test in biochemistry is offered for students who plan to carry on related work. 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 the student's 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 of their students a reading proficiency in a foreign language. An examination in German is scheduled with the proficiency tests for new 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 graduate faculty representative or to

any member of the faculty. Applications for teaching assistantships should be addressed to the graduate faculty representative. A brochure entitled *Graduate Work in Chemistry at Cornell* is available from the graduate faculty representative. The brochure states in some detail the varied research interests 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, J. H. Freed, B. Ganem, M. J. Goldstein, G. G. Hammes, R. Hoffmann, R. E. Hughes, F. A. Long, G. M. Loudon, F. W. McLafferty, J. Meinwald, W. T. Miller, G. H. Morrison, E. L. Muetterties, R. F. Porter, H. A. Scheraga, F. R. Scholer, A. G. Schultz, M. F. Semmelhack, M. J. Sienko, D. A. Usher, B. Widom, J. R. Wiesenfeld, C. F. Wilcox, Jr., Professor-at-Large: M. Eigen

### Civil and Environmental Engineering

**Graduate Faculty Representative:** Peter Gergely, 373 Hollister Hall

**Major and Minor Subjects:** Aerial Photographic Studies\* (M.S. only), Environmental Systems Engineering, Geodetic and Photogrammetric 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 the M.S., or, if a student comes to Cornell with an M.S., within nine months after arrival.

Additional information is available by writing to the graduate faculty representative, School of Civil and Environmental Engineering.

The School of Civil and Environmental Engineering also offers the professional degree of Master of Engineering (Civil), which is intended primarily for persons who plan to practice engineering directly. The professional degree requires a minimum of thirty credit hours of graduate-level work in the principles and prac-

\* Concentration on Aerial Photographic Studies at the Ph.D. level is offered under the subject Geotechnical Engineering.

tices of the field. Specific exit requirements are set for the Master of Engineering (Civil) which include a broad base technical background in the field, courses in design, and professional practice. Students may concentrate in one of the areas within Civil and Environmental Engineering. Additional information may be obtained by writing to the Graduate Professional Engineering Programs Committee, 321 Upson 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 images, 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 and foundation engineering.

**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.** In addition to the conventional aspects of structural analysis and design, interest in this department includes such relatively new topics as computer-aided analysis methods, design of nuclear reactor containment structures, small-scale models, shells, earthquake engineering, optimization, structural safety analysis using probability theory, and structural materials. 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 and Planning.** The major emphasis is in the application of analytical techniques to the handling of transportation problems. The approach is typically multimodal and emphasis is given to problems of urban transportation. Specific interests of faculty members lie in the areas of demand modeling for passenger and freight movements, the development of mass transit systems, airport planning and operation, traffic flow theory, transportation systems analysis, and highway design.

**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 wastewater 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**

- J. F. Abel: structures
- V. C. Behn: sanitary engineering
- D. J. Belcher: aerial photographs
- P. L. Bereano: environmental law and planning
- J. J. Bisogni: sanitary engineering
- W. Brutsaert: hydrology
- F. J. Cesario: transportation
- 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
- P. L.-F. Liu: 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 planning and engineering  
P. J. Murphy: hydraulics  
A. H. Nilson: structures  
T. Pekoz: structural engineering; experimental research  
D. A. Sangrey: soil mechanics  
R. E. Schuler: economics  
R. G. Sexsmith: structures  
C. A. Shoemaker: applied mathematics  
F. O. Slate: engineering materials  
S. Stidham, Jr.: environmental systems  
R. N. White: structures  
R. L. Willis: systems analysis  
G. Winter: structures

### Computer Science

**Graduate Faculty Representative:** John E. Hopcroft, 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.

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. Graduate students should consider majoring in computer science if they are 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 370/168 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.

A booklet describing graduate work in com-

puter science can be obtained by writing to the graduate faculty representative.

### Faculty and Specializations

Numerical analysis: J. H. Bramble, J. E. Dennis, S. P. Han, J. Moré  
Programming languages and systems: G. Andrews, R. W. Conway, A. Demers, D. Gries, W. L. Maxwell, C. G. Moore, D. Severance, R. Teitelbaum, J. H. Williams  
Theory of computations: R. L. Constable, J. Hartmanis, A. Nerode  
Theory of algorithms: J. E. Hopcroft, D. Kirkpatrick  
Information organization and retrieval: G. Salton  
Systems and control theory: C. Pottle  
Adaptive systems: H. D. Block

### Electrical Engineering

**Graduate Faculty Representative:** Paul R. Mclsaac, 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 their major subjects. Applicants are urged to take the Graduate Record Examinations (GRE) and to have the scores sent to the Cornell Graduate School as part of their application materials.

The M.S. and Ph.D. degree programs require submission of a thesis and are intended for students planning to engage in research as a career. Normally the M.S. is not a terminal degree and students should enter the M.S./Ph.D. program.

Prior to their third semester of graduate study students in Ph.D. programs must take a qualifying examination administered by their Special Committees.

In addition to University fellowships the following are available: John McMullen Graduate Fellowship and the Schlumberger Foundation Fellowship. There are also a number of teaching and research assistantships available.

### Professional Degree

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 M.Eng.(E.) is a curricular degree program without a thesis and is intended for students planning careers in engineering design and development in industry. For further information, see the *Announcement of the College of Engineering*.

## 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 electro-physics 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; application of control theory to power 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. H. Bryant, R. R. Capranica, H. J. Carlin, V. W. Chan, G. C. Dalman, L. F. Eastman, W. H. Erickson, D. T. Farley, T. L. Fine, J. Frey, T. Gold, J. Hartmanis, M. Kim, W. H. Ku, C. A. Lee, R. L. Liboff, S. Linke, R. A. McFarlane, H. S. McLaughan, P. R. McIsaac, J. A. Nation, B. Nichols, R. E. Osborn, E. Ott, C. Pottle, E. L. Resler, Jr., J. L. Rosson, R. N. Sudan, G. Szentirmai, C. L. Tang, R. J. Thomas, J. S. Thorp, H. C. Torng, N. M. Vrana, C. B. Wharton, G. J. Wolga

## Environmental Quality

**Graduate Faculty 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. It 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. The field 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 the major field; and a student seeking a doctoral degree will ordinarily take a minimum of five courses, given in at least two areas outside the major field.

## Faculty

B. E. Dethier, N. C. Dondero, L. B. Dworsky, A. W. Eipper, C. D. Gates, D. A. Haith, 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., R. R. Zall, P. J. Zwerman

## Geological Sciences

**Graduate Faculty Representative:** Donald L. Turcotte, 311 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 students 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 their specialty. Students have a wide variety of options in the selection of programs which will best suit their interests and talents. At least one minor subject outside the field is required.

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 applicants' fitness for undertaking advanced studies and will enable the Special Committees to plan a program which will make the students familiar with the requisite knowledge in their chosen areas. 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, study of rocks from the earth's deep interior, measurement of sea level changes and recent crustal movement in the eastern United States, the Southwest Pacific, and elsewhere, seismic reflection profiling of the deep crust and upper mantle, dynamics and mechanics of the lithosphere and asthenosphere, paleontological problems of New York State and elsewhere, engineering geology of selected localities, mapping in Labrador, field geology in Indonesia, 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.

Working agreements with institutions in other parts of the world are maintained by the department 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. Geology is seen as a global science by the department, however, and interests are not limited 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, soil mechanics, aerial photo analysis, fluid dynamics, elasticity, regional planning, hydraulics and hydrology, and materials science and engineering.

### Faculty

J. M. Bird, A. L. Bloom, B. Bonnicksen, J. L. Cisne, B. L. Isacks, D. E. Karig, S. Kaufman, G. A. Kiersch, A. F. Kuckes, G. H. Morrison, J. E. Oliver, A. L. Ruoff, W. B. Travers, D. L. Turcotte

### Materials Science and Engineering

**Graduate Faculty Representative:** Stephen L. Sass, 227 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, nonstoichiometry in ceramic systems
- 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, L. C. De Jonghe, H. H. Johnson, E. J. Kramer, C. Y. Li, T. N. Rhodin, A. L. Ruoff, S. L. Sass, D. N. Seidman, B. M. Siegel, J. Silcox, F. O. Slate, W. W. Webb

### Mathematics

**Graduate Faculty Representative:** O. S. Rothaus, 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 Chairperson, Department of Mathematics, White Hall. A detailed listing of the research interests of the members of the faculty will be sent with the booklet.

**Special Minor in Mathematics:** The Field of Mathematics has instituted a special minor. For details, contact the graduate faculty representative.

### Faculty

I. Berstein, J. H. Bramble, K. S. Brown, S. U. Chase, M. M. Cohen, R. Connelly, G. E. Cooke, R. K. Dennis, C. J. Earle, A. Edmonds, R. H. Farrell, M. E. Fisher, W. H. J. Fuchs, S. S. Gelbart, L. Gross, R. S. Hamilton, D. W. Henderson, K. Ito, P. J. Kahn, H. Kesten, J. Kiefer, A. W. Knapp, S. Lichtenbaum, G. R. Livesay, M. D. Morley, A. Nerode, L. E. Payne, R. A. Platek, A. Rosenberg, O. S. Rothaus, A. H. Schatz, S. Sen, R. Shore, D. A. Singer, F. L. Spitzer, R. S. Strichartz, M. E. Sweedler, A. Torchinsky, L. Wahlbin, H. C. Wang, W. C. Waterhouse, J. E. West

## Mechanical Engineering

**Graduate Faculty Representative:** Sidney Leibovich, 222 Upson Hall

**Major and Minor Subjects:** Mechanical Design, Thermal Power, Thermal Processes

**Minor Subject:** Materials Processing

Applicants 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 their major work. Those without adequate preparation may be required to make up the deficiency.

For the Ph.D. degree candidates must demonstrate reading ability in one of the following languages in addition to their native language: French, German, Russian, or a language approved by petition to the field.

In addition to the two examinations required by the Graduate School, a Ph.D. degree candidate may be asked to take a qualifying examination.

Awards restricted to M.S. and Ph.D. candidates majoring in this field are: Esso Education Foundation Fellowship, John McMullen Graduate Fellowship, Edgar J. Meyer Scholarship, Sibley Scholarship.

### Mechanical Design

This area is concerned broadly with the design, analysis, and manufacture of devices, machines, and systems. At Cornell the common theme of research and instruction is the application of analytical models, computer simulation, and experiment to significant practical problems. Laboratories with a wide range of general and special purpose equipment are supplemented by digital and analog computer facilities.

### Thermal Power

Research and instruction are directed toward the study of energy: its transformation, transport, utilization, and the associated environmental interactions. Laboratories equipped with modern and sophisticated instrumentation are available for experimental work. A nuclear reactor facility as well as digital and analog computer services are provided for student use.

### Thermal Processes

Research areas include basic fluid dynamics, rotating flows, wave motions, numerical studies, and environmental fluid mechanics. Among current research programs in heat transfer are natural convection flows and stability, heat rejection to the environment, and boiling and radiative heat transfer. Combustion studies now in progress involve chemical kinetics, turbu-

lence, fire spread, and the generation of pollutants. Laboratory facilities include a Mach-Zehnder interferometer, a solar furnace, an environmental wind tunnel, devices for measuring secondary flows, hot-wire anemometers, a laser doppler anemometer, and shock tubes.

### Materials Processing

Current and recent research areas include the mechanism of friction welding, thermal fracture of cutting tool materials, and computer-aided design and manufacture of molds for injection molding. Facilities include an extensive laboratory of machine tools and gages, as well as specialized equipment and instrumentation for the study of fundamentals of traditional and nontraditional manufacturing processes.

### 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, transport processes, fluid mechanics, manufacturing engineering, and material removal.

### Faculty and Specializations

*Mechanical Design and Materials Processing*  
Biomechanics, vehicle dynamics, finite elements, hydrodynamic lubrication, mechanical shock and vibration, control systems, computer-aided product design, optimization, reliability, manufacturing processes: D. L. Bartel, J. F. Booker, R. M. Phelan, K. K. Wang, R. L. Wehe

#### *Thermal Power*

Energy conversion, combustion engines, combustion product control, environment control, fuel uses and transformations, power systems, propulsion and nuclear problems, turbomachinery: B. Conta, P. C. T. de Boer, F. C. Gouldin, W. McLean, F. K. Moore, D. G. Shepherd

#### *Thermal Processes*

Transport and fluid dynamics, including buoyancy-induced flows, stability, combustion, radiative and nonequilibrium flows, rotating flows, thermal and chemical pollution: B. Gebhart, F. C. Gouldin, S. Leibovich, W. McLean, F. K. Moore, K. E. Torrance  
Heat transfer and thermodynamics, including convective flows, heat rejection systems, heat transfer in structures, classical, statistical, and irreversible thermodynamics: B. Conta, T. A. Cool, B. Gebhart, F. K. Moore, K. E. Torrance

## Medical Sciences

(See p. 71.)

## Nuclear Science and Engineering

**Graduate Faculty 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 the second term of graduate study, the Ph.D. student is expected to form a Special Committee, which will then administer an informal oral examination designed to guide the 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 Chairperson, 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  $\text{Co}^{60}$  gamma-ray source for radiation chemistry and radiation damage studies; (5) 3 MV 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.

Further information may be obtained by writing to the Nuclear Science and Engineering Graduate Faculty Representative, Ward Laboratory.

### Faculty and Specializations

- K. B. Cady: nuclear engineering; reactor physics; nuclear environmental engineering
- A. P. Casarett: radiation biology
- D. D. Clark: nuclear structure; radiation detection; energy conversion
- H. H. Fleischmann: thermonuclear power; plasma physics
- C. D. Gates: nuclear environmental engineering
- B. L. Isacks: seismological aspects of nuclear power plant siting
- V. O. Kostroun: nuclear and atomic structure; interaction of radiation and matter
- C. Y. Li: fast neutron damage; nuclear materials
- S. Linke: energy conversion
- R. M. Littauer: nuclear instrumentation; pulse electronics
- F. K. Moore: thermal engineering; energy conversion
- G. H. Morrison: nuclear chemistry
- M. Nelkin: neutron scattering; transport and kinetic theory
- J. S. Thorp: systems engineering; controls
- R. L. Von Berg: radiation chemistry; chemical engineering

## Operations Research

**Graduate Faculty 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

### 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 in the third 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 Graduate Faculty Representative, Operations Research.

### 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. Prospective students 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.

Operations research students pursue courses of study and research that emphasize the use of the mathematical, probabilistic, statistical, and computational sciences in the development of the techniques of operations research. Their ultimate goals may range from making fundamental contributions 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 development 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 are 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.** This subject deals 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, ICS 410, 435, 611, 612, 613). The principal campus computing facility is an IBM 370/168. A satellite computer, directly connected to the 370/168, 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
- R. W. Conway: information processing systems; computer science
- P. M. Dearing, Jr.: location theory; operations research
- J. E. Dennis: optimization
- M. J. Eisner: mathematical programming; game theory
- D. R. Fulkerson: mathematical programming; network flow theory
- 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
- J. A. Muckstadt: industrial systems; inventory theory
- G. L. Nemhauser: mathematical programming; operations research
- N. U. Prabhu: stochastic processes; queuing theory; storage theory
- T. J. Santner: statistics; ranking and selection procedures
- 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
- M. S. Taqqu: applied probability
- H. M. Taylor 3d: applied probability
- M. J. Todd: mathematical programming; operations research
- L. I. Weiss: statistical decision theory; sequential analysis; nonparametric statistics

## Physics

**Graduate Faculty Representative:** Kenneth I. Greisen, 113 Clark Hall

**Major and Minor Subjects:** Physics, Experimental Physics, Theoretical Physics

The graduate physics program at Cornell is designed to give students an adequate background in the concepts and techniques of both theoretical and experimental physics to prepare them for careers at the most advanced level in research or teaching. Although the program focuses on the Ph.D. degree, there is a wide variety of options available to students during their 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 for 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 Chairperson, 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, computer simulation of classical and quantum many-body systems, plasma physics, applications of the renormalization group to field theory and critical phenomena, dispersion relations and strong interactions, internal symmetries and their connection with strong interaction dynamics, algebra of currents, quantum electrodynamics, unified weak and electromagnetic interactions; high energy electromagnetic interactions; astrophysics, stellar structure.

**Experimental High-Energy Elementary Particle Research.** Interactions of high-energy electrons and photons with nucleons and with nuclei are studied as well as the detailed structure of the proton and the neutron. Experimental results often provide rigorous tests of the nature of the strong, weak, and electromagnetic forces. Specific experiments include inelastic scattering of electrons, photoproduction of a variety of particles, elastic scattering of electrons and photons.

Facilities for research at Cornell are centered on the 12 GeV electron synchrotron. Two computers and four minicomputers are used in taking and analyzing data. A machine shop and electronics shop provide support for the experiments. Students may also participate in research with the 30 GeV proton synchrotron at Brookhaven National Laboratory and the 400 GeV proton synchrotron at the Fermi National Accelerator Laboratory.

**Experimental Atomic and Solid State Physics.** Thermodynamic and 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 infrared 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, D. G. Cassel, G. V. Chester, R. M. Cotts, J. W. DeWire, M. E. Fisher, D. B. Fitchen, B. Gittelman, K. Gottfried, K. I. Greisen, L. N. Hand, D. L. Hartill, P. L. Hartman, D. F. Holcomb, T. Kinoshita, J. B. Kogut, 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, R. O. Pohl, J. D. Reppy, R. C. Richardson, E. E. Salpeter, R. H. Siemann, A. J. Sievers, R. H. Silsbee, A. Silverman, P. C. Stein, R. M. Talman, S. A. Teukolsky, W. W. Webb, D. H. White, J. W. Wilkins, K. G. 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

(See p. 63.)

### Theoretical and Applied Mechanics

**Graduate Faculty 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; (3) fluid mechanics—Newtonian and non-Newtonian fluids, magnetogasdynamics; (4) mechanics of materials—failure and fracture of solids, static and dynamic properties of solids and fluids; (5) bionics and

robots, pattern classification, mathematical ecology.

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 the 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.

#### Professional Degree

The Master of Engineering (Engineering Mechanics) degree program is intended for students interested in advanced study in mechanics with emphasis on engineering practice rather than teaching or research. The course of study is designed to allow the student to master advanced topics in mechanics and develop skill in applying fundamental concepts in experimental and analytical aspects of mechanics to modern technological problems. For further information see the *Announcement of the College of Engineering*.

#### Faculty

H. D. Block, 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, S. Mukherjee, Y. H. Pao, R. H. Rand, W. H. Sachse

## Water Resources

**Graduate Faculty 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.

This minor field offers qualified engineers and biological, physical, and social scientists an opportunity to gain breadth of knowledge in water resources planning and management through an interdisciplinary program of study intended to complement their major subject.

The minor will represent for each candidate that combination of courses, seminars, and projects outside the major discipline which the Special Committee considers most appropriate to the comprehensive aspects of the degree program.

Major subjects are ordinarily chosen from the following list (see index for field): aerial photographic studies, aquatic ecology, aquatic science, chemical engineering, city and regional planning, economic theory, engineering geology, environmental systems engineering, fishery science, hydraulics and hydrology, 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, B. T. Wilkins, P. J. Zwerman

## Cornell University

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Administration  
E. Hugh Luckey, Vice President for Medical  
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Robert M. Matyas, Vice President for Planning  
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the Graduate School  
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Dean of the Graduate School  
Donald P. Hayes, B.S., M.A., Ph.D., Secretary of  
the Graduate Faculty

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1977.  
Thomas R. Dyckman (Member-at-Large), term  
expires 1977.  
Alfred W. Eipper (Member-at-Large), term  
expires 1975.  
Michael E. Fisher (Member-at-Large), term  
expires 1975.

David B. Lyons (Humanities), term expires 1977.  
Stanley J. O'Connor (Humanities), term expires  
1975.  
Kathleen Rhodes (Social Sciences), term  
expires 1975.  
Sidney Saltzman (Social Sciences), term  
expires 1977.  
Neal F. Jensen (Biological Sciences), term  
expires 1975.  
Ross J. MacIntyre (Biological Sciences), term  
expires 1977.  
David G. Cassel (Physical Sciences), term  
expires 1975.  
P. C. T. de Boer (Physical Sciences), term  
expires 1977.

### University Professors-at-Large

Professors-at-Large are distinguished non-  
resident members of the University faculty. Dur-  
ing 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.

Kenneth Boulding  
Howard M. Brown  
Felix Candela  
Jacques Drèze  
Cora DuBois  
Manfred Eigen  
Northrop Frye  
Sir Ernst Gombrich  
Ralph Gomory  
Louis Guttman  
J. George Harrar  
Sir Fred Hoyle  
H. Gobind Khorana  
Alfred E. Ringwood  
Jacques Roger  
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J. Robert Schrieffer  
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