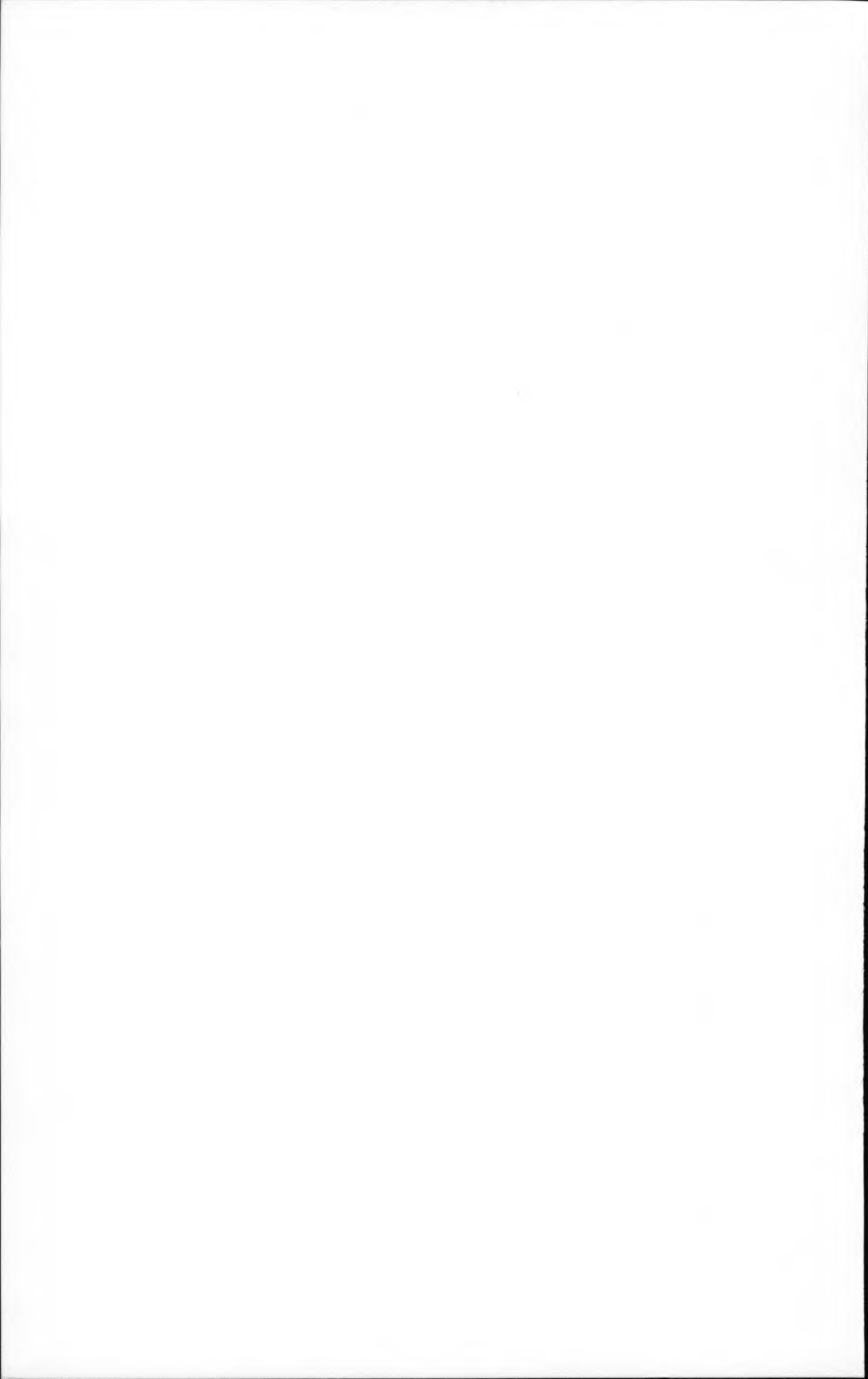


Cornell University Announcements

Graduate School





Cornell University

Graduate School

1986—88

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Cornell University

Tentative Graduate School Calendar

Fall

Registration begins
Registration ends
Instruction begins
Fall recess begins
Instruction resumes
Thanksgiving recess begins
Instruction resumes
Instruction ends
Study period begins
Study period ends
Final examinations begin
Final examinations end

1986-87

Tuesday, August 26
Wednesday, August 27
Thursday, August 28
Saturday, October 11, 1:10 p.m.
Wednesday, October 15, 7:30 a.m.
Wednesday, November 26, 1:10 p.m.
Monday, December 1, 7:30 a.m.
Saturday, December 6
Monday, December 8
Wednesday, December 10
Thursday, December 11
Saturday, December 20

1987-88

Thursday, August 27
Friday, August 28
Monday, August 31
Saturday, October 17, 1:10 p.m.
Wednesday, October 21, 7:30 a.m.
Wednesday, November 25, 1:10 p.m.
Monday, November 30, 7:30 a.m.
Wednesday, December 9
Thursday, December 10
Sunday, December 13
Monday, December 14
Wednesday, December 23

Spring

Registration begins
Registration ends
Instruction begins
Spring recess begins
Instruction resumes
Instruction ends
Study period begins
Study period ends
Final examinations begin
Final examinations end
Commencement

Thursday, January 22
Friday, January 23
Monday, January 26
Saturday, March 21, 1:10 p.m.
Monday, March 30, 7:30 a.m.
Saturday, May 9
Sunday, May 10
Wednesday, May 13
Thursday, May 14
Saturday, May 23
Sunday, May 31

Thursday, January 21
Friday, January 22
Monday, January 25
Saturday, March 19, 1:10 p.m.
Monday, March 28, 7:30 a.m.
Saturday, May 7
Sunday, May 8
Wednesday, May 11
Thursday, May 12
Saturday, May 21
Sunday, May 29

This calendar is subject to modification and is not legally binding.

The Law School calendar differs in a number of ways from the University academic calendar. Please consult the *Announcement of the Law School* for details.

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

Announcements

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



Cornell University

Graduate School

The graduate program at Cornell emphasizes flexibility and independence and permits an unusual degree of accommodation to the needs and interests of the individual student. Degree requirements are kept to a minimum, and except in some professional degree programs, there are no credit-hour requirements.

The Graduate School is organized into eighty-eight major fields, or subject areas, independent of traditional college and department units. Under this arrangement, a field may draw its graduate faculty from several disciplines and departments, and students are exposed to the widest range of scholarship in their respective areas of study. While the major subject is chosen from the field into which the student is admitted, minor subjects are frequently drawn from other related fields. This further enhances the opportunity to plan a course of study that meets the specific needs of each student.

A close working relationship with faculty is essential to the graduate program at Cornell. Under the Special Committee system, the student is guided by, and works with, at least two or three faculty members chosen by the student to represent his or her major and minor subjects. The representative for the major subject is the chairperson of the Special Committee and usually has the primary responsibility for directing the student's thesis research.

Students in some of the professional master's programs have advisers rather than Special Committees directing their programs. Frequently, the adviser is assigned to the student by the field.

Approximately 4,000 students are enrolled in the Graduate School and are supervised by a graduate faculty numbering about 1,500. Details of the organization, regulations, and programs of study are described in the following pages.

Admission

Applicants are encouraged to communicate with individual members of the Graduate Faculty with whom they may want to study. Personal interviews are especially encouraged for students who wish to learn more about particular programs before applying. For

the benefit of those not acquainted with faculty members in the field or fields of their interest, each field has a graduate faculty representative who serves as director of graduate studies and 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 should (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; and (4) present evidence of promise in advanced study and research. In general, successful applicants will have a combined score of at least 1,200 in the verbal and quantitative aptitude tests of the Graduate Record Examinations (GRE) for those fields that require the GRE. Applicants from United States colleges and universities should be in the top third of their graduating class.

It is the policy of Cornell University actively to support equality of educational and employment opportunity. No person shall be denied admission to any educational program or activity or be denied employment on the basis of any legally prohibited discrimination involving, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, sex, age, or handicap. The University is committed to the maintenance of affirmative action programs which will assure the continuation of such equality of opportunity.

Cornell University is committed to assisting those handicapped students who have special needs. A brochure describing services for the handicapped student may be obtained by writing to the Office of Equal Opportunity, Cornell University, 234 Day Hall, Ithaca, New York 14853-2801. Questions or requests for special assistance may also be directed to that office.

The information contained in this Announcement is accurate as of the publication date. For possible changes consult the Office of the Graduate School.

Categories of Admission

Degree Candidates

It is expected that most applicants for admission will pursue a program for an advanced degree. Applicants may specify candidacy for the Ph.D. degree, the Master of Arts degree, the Master of Science degree, or one of the professional degrees. Since Cornell has a strong commitment to doctoral work, most students are encouraged to enroll in a doctoral program. In some fields, students interested in a doctoral program may be required to earn a master's degree first.

Provisional Status

A qualified applicant whose academic background is difficult to evaluate may be admitted as a provisional candidate. Ordinarily only one semester of study in that status is permitted, and the student who has failed to perform satisfactorily at the end of that time may be requested to withdraw from the University.

Non-Degree Status

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. Applicants for non-degree status must satisfy all the entrance requirements expected of degree candidates. Registration as a non-degree student is restricted to two semesters.

Change of Status

A student who wants to change from non-degree status to degree status or from one degree or field to another, or who, after receiving the master's degree, wants to undertake candidacy for the doctorate, must submit to the dean of the Graduate School a petition giving reasons for the proposed change. (A provisional candidate is automatically reviewed at the end of the semester; therefore, no letter is necessary.)

Application Procedures

Applications for admission should be requested from the Graduate School, Cornell University, Sage Graduate Center, Ithaca, New York 14853-6201. The following supporting documentation is required: letters of recommendation from two instructors who are acquainted with the applicant's work in the major area of study; official transcripts from all the institutions of higher learning attended; and, where required, scores from the Graduate Record Examinations.

A student may apply to only one field at a time. However, an alternate field of interest may be indicated on the application. The application of a student rejected in the first-choice field will then be transferred automatically to the alternative field.

All applications must be accompanied by a \$35 nonrefundable fee.

Graduate Record Examinations

The Graduate Record Examinations (GRE) are administered by the Educational Testing Service. Further information may be obtained by writing to the Graduate Record Examinations, Box 955, Princeton, New Jersey 08541.

The fields of instruction, described beginning on page 33, should be consulted for fields requiring the scores of the aptitude tests and the appropriate advanced (subject) test. Applicants should arrange to have scores sent directly to the Graduate School from the Educational Testing Service. Fellowship applicants, especially, are urged to take the GRE aptitude tests no later than December and to have the scores sent to the Cornell Graduate School as part of their application file.

Students applying from institutions with S-U grading systems, particularly if they have received S-U grades in major and related subjects, are strongly urged to submit GRE aptitude and advanced (subject) test scores. Without these scores there may be little useful information with which to judge admissibility.

Graduate Management Aptitude Test

Some fields also require that applicants submit scores from the Graduate Management Aptitude Test (GMAT). It is the applicant's responsibility to ascertain whether or not the field of interest has this requirement. The Field of Education also accepts the Miller Analogies Test.

Competency in English

Before admission can be final, all applicants whose native language is not English must provide proof of competency in the English language. Acceptable proof could be (1) a Test of English as a Foreign Language (TOEFL) score of 550 or higher or (2) a degree from a college or university in a country where the native language is English or (3) two or more years of study in an undergraduate or graduate program in a country where the native language is English. Because of heavy reading requirements, some fields may require a minimum TOEFL score of 600.

The TOEFL is offered worldwide six times a year. Information about the time and place of each of the test administrations, as well as a test application form, may be obtained by writing to the Educational Testing Service, Princeton, New Jersey 08540. The test score must be reported directly to the Graduate School by the testing organization. Only conditional admission will be offered until the scores have been received.

A successful applicant whose TOEFL score is between 550 and 600 must take an English placement examination given at Cornell during registration week. (Registration material will be withheld from any student in this category who does not take this examination.) If the examination score indicates that the student needs additional formal training in English, either a three- or six-credit course will be required during the first semester. Applicants must be prepared to fulfill—and sponsors and advisers to accept—this requirement.

It may be possible for a student receiving a TOEFL score between 500 and 550 to be accepted for the fall semester on the condition that he or she attend an intensive English course in the summer session at Cornell and continue English instruction in the fall if necessary. Similarly, a student whose TOEFL score is between 500 and 550 may be accepted for the spring semester on the condition that he or she enroll in the Intensive English Program in the preceding fall semester. Applicants who attend English language programs elsewhere must submit a minimum TOEFL score of 550 to be admitted to the Cornell Graduate School.

Under certain circumstances, if it is impossible to arrange to take the TOEFL in sufficient time, an American Language Institute: Georgetown University (ALIGU) test score of 90 or higher may be accepted in lieu of the TOEFL. This arrangement, however, is discouraged. All applicants submitting an ALIGU score must take the Cornell English placement examination before being permitted to register.

Financial Support

The application for admission to the Graduate School is also the application for fellowships and assistantships; no additional form is needed. Applicants indicate the types of support for which they want to be considered by answering the pertinent questions on the form. Applications for loans and work-study aid can be obtained from the Graduate Financial Aid Office, Cornell University, 104 Sage Graduate Center, Ithaca, New York 14853-6201. All applicants are requested to submit a Graduate and Professional School Financial Aid Service (GAPSFAS) form. See p. 9 for further information.

Application Deadline

Although applications for admission to the Graduate School may be submitted at any time throughout the year, many fields require that completed applications be received by a specific date. In most cases, this is January 15. Applicants should check with the field(s) of interest. Foreign students should complete their applications as early as possible to allow time for the admissions office to evaluate admissibility, financial support, and to issue certificates of eligibility for visas.

Applicants for fall admission who are also applying for Cornell fellowships awarded by the Graduate School must submit their applications and all supporting documents by January 15.

Notification of Admission and Financial Aid

If application is made for the fall term and supporting documents are received by January 15, every effort will be made to notify the applicant of admission action no later than May 1. Applicants who have been accepted for admission should inform the Graduate School as early as possible whether they intend to accept the admission offer.

As agreed upon by some of the members of the Council of Graduate Schools in the United States, *successful* fellowship applicants will be notified of their award by April 1. It is not possible to inform other applicants of the outcome of the fellowship competition.

Applicants awarded assistantships will hear directly from the fields to which they have been admitted.

Tuition and Fees

The bursar's office mails statements to those students who incur charges and to those who have amounts due the University on or about the tenth of each month to the address designated by the student.

Tuition is billed on a per-term basis on the tenth of August and January. Charges not billed on the first statement will appear on a subsequent monthly statement.

All charges are payable in full within twenty days of the billing date. Any amounts remaining unpaid, in whole or in part, after the due date of the statement on which the charges first appeared will be assessed a finance charge at the rate of 1 1/4 percent per month (15 percent annual interest rate).

A person who has outstanding indebtedness to the University will not be allowed to register or reregister in the University, receive a transcript of record, or receive a certification letter for an advanced degree.

The amount, time, and manner of payment of tuition, fees, or other charges may be changed at any time without notice.

Tuition

The following tuition charges are for the 1985-86 academic year; increases are anticipated for the 1986-87 and 1987-88 academic years.

A student pays either endowed or statutory tuition, depending primarily on the college affiliation of the chairperson of the Special Committee or of the adviser, as relevant. If the chairperson or adviser (see p. 10) has an appointment in one of the statutory colleges—College of Agriculture and Life Sciences, College of Human Ecology, School of Industrial and Labor Relations—the tuition charge is \$5,020 for the academic year. If the Special Committee chairperson is in the College of Veterinary Medicine, tuition is \$7,400. When the chairperson or adviser is in one of the endowed colleges—College of Architecture, Art, and Planning; College of Arts and Sciences; College of Engineering; School of Hotel Administration—the tuition charge is \$10,500. If the chairperson is in the Johnson Graduate School of Management, tuition is \$11,100, and in the Law School it is \$10,830. Students in the Division of Biological Sciences, which includes both endowed and statutory units, pay the statutory tuition.

Any student who is to receive less than full residence credit because of employment should apply for proration of tuition on forms available at the Office of the Graduate School. Tuition is based on residence eligibility (see pp. 11-12).

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Regularly registered doctoral candidates who have completed six units of residence at Cornell, have passed their admission to candidacy examination, and are no longer taking courses will be eligible for reduced tuition (\$2,000 a year in 1985–86). Those students will be eligible to receive funding from Cornell sources while on reduced tuition.

The Office of Financial Aid has estimated the minimum cost of living for a graduate student for the 1985–86 academic year as follows (figures include cost of books, room and board, and personal expenses): single student, \$7,150; single parent, 8,680 (one child); married couple, \$10,330. The estimated cost for dependent children is \$1,650 a child. Cost of tuition should be added to the above figures to arrive at each student's cost of attendance for the academic year. Students from abroad should add to the above estimates living expenses for the three-month summer period.

Refunds

Part of the amount personally paid for tuition may be refunded if the student petitions for an official leave of absence or withdrawal from the Graduate School during the semester. Students who terminate their registration in the University during a regular term in this manner will be charged tuition from the registration day to the effective date of the leave or withdrawal as follows: 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. No charge will be made if the effective date of leave or withdrawal is within the first six days of the term, including registration day.

The University makes available tuition insurance that provides refunds in the event of leave of absence or withdrawal for medical or emotional reasons. Complete details regarding this coverage and applications accompany the August tuition bill.

Tuition will be prorated on a daily basis for graduate students who have obtained a leave of absence for medical reasons. A medical leave of absence can be obtained only through Gannett Health Center.

Summer Tuition

Graduate students who attend classes in the summer session must register both in the Graduate School and in the Division of Summer Session, Extramural Study, and Related Programs. They pay the tuition and fees listed in the *Announcement of the Summer Session*. Students who register for residence credit for summer are charged by the fraction of the residence unit to be earned, based on the subsequent term's tuition. If a student has paid tuition to the Division of Summer Session and also registers for residence credit in the Graduate School, the charge for Graduate School registration will be reduced by the amount paid to the Division of Summer Session.

Students who file for summer research on a non–residence-credit basis (SGR) do not pay tuition or fees if they have been in residence on campus for at least one semester in the preceding academic year. Those who have not been in residence in the preceding year and who register SGR pay a fee of \$5 per week.

Other Fees

In Absentia A graduate student registered in absentia pays a fee of \$200 each fall and spring term.

Active-File Fee Doctoral candidates filing leaves of absence or failing to register will be required to pay an active-file fee of \$200 for each semester, up to a maximum of six semesters (\$1,200), during which they are not registered with the Graduate School. The fee will not be subject to finance charges but must be paid before the student can receive a diploma, a transcript, or a certification letter. Petition for waiver of this fee will be considered for students who have not completed their required residence units.

Candidate for Degree Only In order to take a final examination, a student must be registered in the Graduate School as a regular student (either in residence or in absentia) as a Candidate for Degree Only (CDO) on the day of the examination; the fee is \$35. A nonregistered doctoral candidate who is required to pay an active-file fee of \$200 for the semester during which the exam is taken, however, will not be required to pay the CDO fee; the CDO form should be filled out to make the registration official. Students registered full-time during the fall or spring term may take a final examination during the following summer without further registration.

Thesis Fee Each doctoral candidate must pay \$60 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, publishing the abstract in the monthly periodical *Dissertation Abstracts International*, mailing the microfilm and abstract to the microfilm publisher, and binding both copies of the thesis for deposit in the University Libraries.

Other Fees Information about fees for special services, penalties and appeal procedures, refunds, and other financial matters is available in the catalog *Courses of Study*.

Financial Support

(See application and notification procedures on pp. 6–7)

Extensive financial resources are available to help Cornell graduate students with educational costs. In recent years, more than 80 percent of the graduate students received financial assistance, either from Cornell fellowships, teaching assistantships and research assistantships, or from outside sources. But outside support is sharply diminishing, and the number of students with fellowships or assistantships is also expected to decrease. Since the demands of graduate study are so great, students are discouraged from trying to support themselves by unrelated employment.

Applicants are reminded that financial aid awards normally are made on an academic-year basis, and it is unlikely that students entering in the spring semester would receive financial assistance for that term.

All applicants to the Graduate School are requested to submit a Graduate and Professional School Financial Aid Service (GAPSAS) form providing an estimate of financial need. Knowing the number of students with documentable need will allow the University to obtain maximum federal funding for loans and work-study purposes. Applicants should obtain the necessary form, available at college or university financial aid offices and from the Educational Testing Services, file it with the Educational Testing Service, Box 2614, Princeton, New Jersey 08541, and request that the information be sent to Cornell (code: 2165). Many financial aid offers from Cornell will not include a need-based component. If applicants apply for financial support from Cornell but do not file a GAPSAS form, they will be considered for such non-need-based aid.

Fellowships

Fellowships are awarded to full-time students who are candidates for a higher degree (usually a Ph.D.) primarily on the basis of scholastic ability and promise of achievement. The holder of a fellowship may accept no other award or employment for more than eight hours a week without permission of the Cornell Graduate Fellowship Board. More than 300 fellowships (some of which are restricted to specific areas of study) are under the direct supervision of this board or of academic units of Cornell. The following Cornell fellowships are available to first-year students: Andrew D. White Fellowships (\$7,500), Sage Graduate Fellowships (\$6,000), Cornell Graduate Fellowships (\$6,000), fellowships from special endowments (\$1,000 to \$6,000), and industrial fellowships (\$1,500 to \$10,000). Most recipients also receive full-tuition fellowships. Candidates for Cornell fellowships are nominated by the field from among those students applying.

To achieve ethnic diversity, Cornell provides fellowships to minority applicants who are not offered support through other channels. These are for one academic year. The student does not apply for these fellowships directly but is nominated by the field granting admission. Continuing support is awarded at the discretion of the individual fields, which offer tuition and fees and both teaching and research assistantships.

Prospective graduate students should also consider applying for outside fellowships from foundations, industrial concerns, and national, international, or government agencies. Students receiving a Cornell fellowship and an outside award may be permitted to hold both concurrently, although an adjustment may be made in the Cornell award.

NRF Fellowships

Applications for National Resource Fellowships (NRF) (formerly National Defense Education Act—Title VI: Foreign Language and Area Studies Fellowships) are available at the Graduate School Fellowship Office, 116 Sage Graduate Center, or from the appropriate

international studies program. The purpose of the NRF program is to provide encouragement to persons taking advanced training in languages and in associated area studies designated of critical importance to the United States. NRF applications are available beginning in mid-November and must be received by the Graduate School by the announced deadline (usually mid-January). Cornell University currently submits proposals for NRF funding for the following world areas: East Asia, East Europe and the USSR, Latin America, South Asia, Southeast Asia, and Western Europe. Funds may be available for intensive summer language study in addition to funds for the academic year, depending on the program applied to.

Assistantships

Applicants interested in assistantships should indicate that fact on the Graduate School application form and should also write directly to the graduate faculty representative in the field of interest. There are four types of assistantships available: teaching, research, graduate research, and graduate assistantships. Only full-time students are eligible for assistantships.

Incoming graduate students holding teaching or research assistantships receive a stipend for the academic year. Basic stipend levels for incoming students in 1985–86 were \$5,600 (nine-month). In addition, most students holding teaching and research assistantships are nominated for and receive tuition fellowships. Summer stipends and fellowships are also available.

Graduate research assistants usually receive an amount that covers tuition plus a stipend (\$5,600 for nine months in 1985–86). A limited number of summer appointments are available. Graduate assistants receive a stipend, the amount of which is determined at the time of appointment. They may also receive a partial or full tuition fellowship.

Teaching Assistantships

An appointment as a teaching assistant is usually in the student's major field or in one that is closely related. The duties ordinarily require approximately fifteen clock hours of the student's time a week. A teaching assistant whose duties are in the major field of interest and do not require more than fifteen hours work a week is eligible for full residence credit. (Most teaching assistants are funded through department sources, but some may be partially supported on college work-study funds.)

Research Assistantships

The duties of a research assistant involve work on a research project. The student is usually required to work about fifteen hours a week; full residence credit can be earned if the research is in the field of major interest.

Graduate Research Assistantships

A student whose research interest coincides with a supported research project may receive a graduate research assistantship, with the understanding that

10 Degree Requirements

thesis research will contribute to, and be appropriate for, the project. No time commitment is specified, but since a student devotes considerable time to thesis research, the time spent on this work is expected to be significant.

Graduate Assistantships

Graduate assistants perform services—teaching, grading, research, or other assignments—for the department. They may work up to twenty hours a week but usually work ten hours a week or less. They will receive a stipend and may also receive a partial or full tuition fellowship.

Other Support

Prizes

Several University prize competitions are open to graduate students. A booklet, *Prize Competitions*, which describes all regularly established prizes, may be obtained by persons on campus from the Office of the Dean of Faculty, 315 Day Hall.

Tuition Assistance Program (TAP)

Students who are legal residents of New York State may be eligible for a Tuition Assistance Program (TAP) award. Information and application forms may be obtained from the New York State Higher Education Services Corporation, Student Financial Aid Section, Tower Building, Empire State Plaza, Albany, New York 12255. (Students who receive tuition awards from Cornell are required to apply for a TAP award if eligible; the Cornell award will be reduced by the amount of the TAP award.)

Need-based Financial Aid

Cornell University's Graduate Financial Aid Office administers several loan programs for graduate students who are registered as degree candidates and who are either United States citizens or permanent residents. Applicants to the Graduate School, as well as registered students, must file a GAPSFA form by mid-March to be considered for University need-based scholarships, loans, or work-study aid. All applicants for need-based aid must also complete and file a Cornell University need-based financial aid application. This form may be obtained from the Graduate Financial Aid Office, 116 Sage Graduate Center.

Applications for the National Direct Student Loan Program and for University loans are also available at the Graduate Financial Aid Office. Applications should be submitted by mid-April for the following fall semester. Increasingly, the University is referring both undergraduate and graduate students to their respective state loan programs. Applications for these programs may be obtained from the student's home bank.

For further information about need-based financial aid, please contact the Graduate Financial Aid Office, 116 Sage Graduate Center.

Residence Hall Positions

Graduate and professional students are eligible for employment as in-residence staff in the undergraduate and graduate residence halls at Cornell. Compensation packages vary according to the position (head resident, program assistant, or resident adviser) and may consist of all or portions of tuition, room, and salary in various combinations. The time commitment is comparable to that required of a teaching or research assistant. Information about those positions is available through the Department of Residence Life, 2117 North Balch Hall. Because applicants must participate in an extended on-campus selection process, positions are generally not available to entering graduate students.

Part-Time Employment

Opportunities for part-time work, including the federally funded College Work-Study Program (CWSP), are often available in connection with departmental research projects or other activities. Applications for such work should be made directly to the department concerned or to the Student Employment Office, 203 Day Hall. Candidates may find that employment in research or other work closely allied to their academic interests is of value; on the other hand, progress in the degree program is difficult when students attempt to support themselves wholly or partially by work unrelated to their studies.

Employment for Spouses of Students

Some nonacademic positions for students' spouses are available at Cornell University; application may be made through Staffing Services, 130 Day Hall. In addition, the Ithaca area offers employment in small industrial plants, at Ithaca College, in the local hospital, and in various businesses. Because of the high number of well-educated men and women in the University community, however, it is not easy to find employment in the Ithaca area. As a result, many highly qualified people accept positions in semiskilled jobs outside their professions.

Degree Requirements

Degree requirements of the Graduate School are kept at a minimum to give the student maximum flexibility in choosing a program of study. Since progress in graduate study depends so much on the individual student's situation, no credit hour or grade requirements are imposed by the Graduate School. Grades of C+ and below, however, do not normally constitute satisfactory progress for a student enrolled in the Graduate School.

Special Committees and Advisers

The Graduate School is organized into fields of study, independent of colleges and departments. A student is admitted to a specific field and selects a major subject and/or area of concentration from among those listed under that field in this Announcement. Minor subjects may be chosen from the field and/or other related fields.

The program of most graduate students is developed with the aid and direction of the student's Special Committee, which is composed of members of the Graduate Faculty chosen by the student to fit his or her particular needs and interests.

The Special Committee for a master's candidate is composed of a chairperson, who represents the major subject, and one representative of a minor subject. The Special Committee of a doctoral student is composed of a chairperson, representing the major subject, and two other members from other areas of interest. The chairperson of the Special Committee usually directs the student's thesis research. Most fields require two minor subjects for doctoral programs, but a few require only one.

A student may ask any member of the Graduate Faculty in his or her field to serve as chairperson and to represent the major subject. The chairperson, in turn, advises the student about minor subjects and Graduate Faculty members who might represent them on the student's Special Committee. It is the privilege of a faculty member to decline at any time to serve on a student's Special Committee.

The student's major and minor subjects and the names of the members of the Special Committee should be recorded in the Graduate School within three weeks of the beginning of classes. In some of the larger graduate fields, where it may be difficult for a new student to make a wise selection of committee members, the graduate faculty representative or other faculty member may serve temporarily as the chairperson until the student forms a permanent committee. Students are encouraged to change the membership of their Special Committee as their aims become more definite. A change of committee must be reported on the Change of Special Committee form supplied at the Graduate School office. A change in the Special Committee after the Admission to Candidacy Examination requires the approval of the General Committee of the Graduate School.

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 approve the thesis. Although the committee and the student constitute an independent working unit, all members of the Graduate Faculty are free to participate in the scheduled examinations and to review the theses of candidates for degrees.

In some professional master's programs, a student has an adviser (frequently appointed by the field) rather than a Special Committee to direct his or her program.

Residence

The Graduate Faculty regards study in residence as essential. Although students 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, students need persistent and continuing interaction with others engaged in similar pursuits.

Attendance at lectures, seminars, and other academic meetings on campus also is considered an important part of graduate education.

All candidates for a graduate degree must earn a specified number of residence units. One semester of full-time study in residence at Cornell at an acceptable level of performance constitutes one residence unit. Candidates for a master's degree normally take between one and two years of satisfactory full-time study to complete all the degree requirements. A minimum of two residence units must be earned before the degree is granted. Candidates for the Ph.D. degree normally take four or five years of satisfactory full-time study to complete all the degree requirements. A minimum of six residence units must be earned before the degree is granted.

A student in an M.A./M.S. program may earn no more than one unit, and a student in a doctoral program no more than two units, for all work done in summer session, summer research, 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.

Certain professional degree programs have specific residence requirements different from those stated above. Students should check the professional program of interest to determine those requirements.

A student should complete all the requirements for the master's degree in four years from the date of first registration in the Graduate School; a maximum of seven years is allowed for completion of the doctoral degree. In both cases, a student can petition for an extension.

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. (See also the information on the active-file fee and on reduced tuition, p. 8.)

Transfer of Residence Credit

A candidate for the M.A. or M.S. degree may not receive residence credit for previous study in other graduate schools. A candidate for the doctorate may be granted a maximum of two residence units for a master's degree earned at another institution if that degree is relevant to the doctoral program. No commitment regarding transfer of residence credit may be made until after the student has earned one residence unit and the Special Committee has had an opportunity to judge the student's accomplishments.

Summer Session

To receive residence credit for summer session, the candidate must register in both the Division of Summer Session, Extramural Study, and Related Programs and in the Graduate School and must file a statement of courses satisfactory to the Special Committee. A student may, with prior approval of the Special Committee, earn one-half of a residence unit by completing eight credits or more in the eight-week session or two-fifths of a unit for six credits or more in the six-week session. Residence credit for study during

one summer session preceding registration in the Graduate School may be transferred 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 receive residence credit for summer research, students need register with the Graduate School only. Students may also register for summer graduate research on a non-residence-credit basis (see p. 8).

Proof of summer registration (a valid summer ID) is necessary for all students who want to use Gannett Health Center and the libraries, certify G.I. benefits, establish foreign-student certification, or receive assistance or financial aid from the Graduate School.

Part-Time Studies

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

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

Employment	Maximum Residence Units Allowable	
	On campus	Off campus
Total clock hours per week		
0-20	1 unit	½ unit
21-30	¾ unit	(see below)

If employment is off campus and is more than twenty hours a week, or if employment is over thirty hours a week, a maximum of ¾ of a residence unit can be earned. Approval of the General Committee of the Graduate School is required.

Students enrolled in the Division of Extramural Courses are not considered to be registered as graduate students but may accumulate some residence units. Fifteen credits completed through the Division of Extramural Study are equivalent to one residence unit, and six credits are equivalent to two-fifths of a unit. Detailed information on extramural courses and registration procedures may be obtained from the Division of Extramural Study, B12 Ives 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 the examinations may be oral or oral and written. The examinations must be scheduled at least

seven days in advance in the Graduate School office. A final examination is required for an M.A. or M.S. degree and under certain conditions may be combined with the Admission to (Ph.D.) Candidacy Examination. A final examination is required in some professional master's programs.

Two examinations are required for the doctoral degree. The comprehensive Admission to Candidacy Examination for formal admission to doctoral candidacy may be taken after a student has earned at least two units of residence credit. This examination must be passed before seven residence units have been accrued, and at least two units must be earned after completing the examination. The 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 of study.

In fields that so desire, the Special Committee may, after the Admission to Candidacy Examination has been taken, nominate the student for a special master's degree without the requirement of a thesis. The master's degree may be given whether or not the Admission to Candidacy Examination for the Ph.D. has been passed. Four units of residence must have been earned for a special master's to be awarded.

Foreign Language Requirements

The fields that consider foreign languages useful to their particular area have their own requirements. 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 M.A. or M.S. are required to submit a thesis in fulfillment of the requirements for the degree (except for the special master's described above). Some fields also require a thesis or a special project for professional master's degrees. Candidates for the doctoral degree must complete a thesis that constitutes an imaginative contribution to knowledge. The faculty requires publication of Ph.D. theses by abstract and microfilm.

General Information

Living Arrangements

Further information about, and application forms for, the University housing described below may be obtained from the Housing Assignment Office, 1142 North Balch Hall.

Residence Halls Sage Hall, on the central campus, accommodates approximately 190 men and women. Schuyler House, a recently renovated graduate residence hall near the campus houses approximately 150 men and women. Thurston Court Apartments, on the North Campus, has eighteen single and double units for graduate men and women.

Family Housing Unfurnished apartments for students with families are available in Cornell Quarters, Pleasant Grove Apartments, and Hasbrouck Apartments. These house a total of 421 families of no more than four members each.

Off-Campus Housing The Off-Campus Housing Office maintains a board with listings of available off-campus accommodations. Because these change constantly, it is not practical to mail listings, nor is it feasible to maintain a waiting list of persons seeking accommodations. A booklet that describes off-campus housing in the Ithaca area is available from the Off-Campus Housing Office, 103 Barnes Hall.

Health Requirements on Entrance

Each entering graduate student must submit a health history on the form supplied by the University. Tetanus immunization, although not required, is strongly advised; either a primary or a booster immunization may be obtained at the Gannett Health Center 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 provided at Gannett Health Center. Students are entitled to unlimited visits to the center. Appointments with individual doctors at the center may be made by calling or going there in person. An acutely ill student will be seen with or without an appointment. Students also are entitled to routine laboratory and X-ray examinations indicated for diagnosis and treatment, overnight care, short-term psychological care, and emergency care. If a student prefers to consult a private physician rather than go to the center, the cost must be borne by the student.

In order to protect the student while on vacation or for hospitalization in Ithaca, Cornell has an accident and sickness insurance plan to supplement the services outlined above. Students are automatically enrolled in this insurance plan and must complete a waiver form to be exempted from the plan. Waiver forms are enclosed with the insurance bill that is sent by the bursar's office. Students are billed for insurance each fall and must either pay for the insurance or return the completed waiver form each year. Information about this insurance may be obtained at Gannett Health Center from the insurance company representative.

Spouses of regularly enrolled students may use the University health services on a prepaid or fee-for-service basis. Spouses and dependents also may be

enrolled in the accident and sickness insurance plan. Additional information may be obtained at Gannett Health Center.

Transportation Services

Traffic and Parking

To provide a safe walking environment for pedestrians on campus and to reduce the impact of motor vehicles on the limited campus parking facilities, Cornell has restricted vehicle access to the central campus. Cornell University encourages ridesharing and the use of other modes of transportation such as public transit, bicycling, and walking.

The University requires that all members of the campus community register annually with the Traffic Bureau any motor vehicles (including motorcycles, motor scooters, and mopeds) in their possession that are at any time operated or parked on the Ithaca campus.

Virtually all on-campus parking is by permit only, except in certain visitor areas. Parking permits may be obtained at the same time that a vehicle is registered. A complete listing of parking and traffic regulations is available at the Traffic Bureau.

New York State Motor Vehicle and Traffic Laws are enforced on the Cornell University campus.

The Traffic Bureau will be glad to assist those who have general inquiries, special access needs for medical reasons, or other requests. Correspondence should be directed to the Traffic Bureau, Cornell University, 116 Maple Avenue, Ithaca, New York 14850-4902.

Bus Service

Campus Service CU Transit buses offer campus service to the peripheral parking lots, Collegetown, and West Campus and on the Blue Light and East Ithaca routes. Buses appear at five-, eight-, or fifteen-minute intervals on central campus, depending on the route and time of day. Services to peripheral areas are generally at half-hour or hourly intervals.

Evening Bus Service When classes are in session, the Blue Light Bus operates from 6:27 p.m. to 1:15 a.m. seven days a week. Evening transit service is also available on Ithaca Transit's route 2A; buses run between Cornell, downtown Ithaca, and Ithaca College until 1:17 a.m. Monday through Saturday evenings.

The Blue Light Escort Service is also available during the evenings of the regular academic year for persons traveling on foot to nearby residential and parking areas. Call 256-7373 in advance to be met by a trained and radio-equipped escort.

One or more of the CU Transit bus routes are accessible to residents of North Campus, Hasbrouck and Pleasant Grove Apartments, Cornell Quarters, Cornell Heights, Collegetown, and West Campus.

Local Bus Service Several transit services operate in Ithaca, on the Cornell campus, and to rural areas under the auspices of TOMTRAN, Tompkins County's transportation network. For information, call CU Transit

at 256-3782 or TOMTRAN at 274-5286. Schedules are available from drivers and Cornell's Information and Referral Center in the lobby of Day Hall.

Activities for Graduate Students

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

Many graduate students participate with undergraduates in extracurricular activities such as intramural sports, the Glee Club, the Sage Chapel choir, publications, and folk dancing. Staff within the Dean of Students Office advise the graduate student activities committee and Grads for Grads (which is active in scheduling social events specifically for graduates), as well as sponsor Graduate Orientation and many other events throughout the year. A Graduate Wives' Club promotes activities for 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. Cornell United Religious Work, located in Anabel Taylor Hall, serves as an information and referral agency for the varied religious activities that take place on campus. The Center for Religion, Ethics, and Social Policy, also in Anabel Taylor Hall, is open to graduate students.

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; several gymnasiums, and riding stables. A number of ski areas are 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 or her Special Committee. The coordinator of graduate student programs and other counselors in the Dean of Students Office are also available to help graduate students with a wide range of problems and concerns. Other services are available in the International Student Office, Sage Graduate Center, Gannett Health Center, and the Cornell United Religious Work office.

International Student Office

Cornell has, since its founding, welcomed students from abroad. Currently about 1,400 foreign students representing 95 countries are studying here. Over 1,000 of the foreign students are enrolled in the Graduate School.

The International Student Office is located in 200 Barnes Hall. Students from abroad must 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 that enrich the cultural life of Cornell.

Ithaca families participate in the International Student Hospitality Program, in which foreign students are invited to share in some aspects of American family life in the community. Ithaca, because of Cornell, has a more cosmopolitan atmosphere than most other small cities, and a student can usually find an outlet for a wide variety of interests.

University Career Center

The University Career Center, an academic support service, works in conjunction with college career planning and placement offices to help students explore, discover, and choose a career. It provides assistance in six major areas: academic and career counseling, career information, health careers, job hunting, special programs for minorities, and professional and graduate school advising. Professional advisers and counselors and student advisers are available.

The office in Sage Hall (telephone: 607/256-5221) houses an extensive career library with resources on careers and career decision making, employment, graduate and professional schools, and study abroad programs, and video and audio tapes. It also offers seminars on applying to graduate and professional schools, aids students in job hunting through on-campus interviews with employers and through the Cornell Connection, which taps the hidden job market with the help of alumni who serve as contacts. In addition, students can obtain firsthand knowledge of a variety of career fields through one-on-one discussions with Cornell alumni participating in the Alumni Career Advisory Network, another phase of the Cornell Connection program. Finally, the needs of minority students are addressed through special programs and advising.

The office in 203 Barnes Hall provides academic and career counseling to individuals and groups, conducts academic and vocational testing, and gives language placement tests to students enrolling in foreign language courses (telephone: 607/256-5044). It maintains a credential service for letters of recommendation, transcripts, and other personal documents retained and distributed by request to employers and graduate and professional schools (telephone: 607/256-3559) and provides special information resources and advice for students interested in careers or professional schools in the health career fields (telephone: 607/256-3519).

Two additional sources of information provide a more detailed introduction to the services and programs offered by this office: the "Career Planning and Job Hunting Program Calendar," published at the beginning of the fall and spring semesters, and the "Career Center News," appearing each Monday in the *Cornell Sun*. For more information on the Cornell Connection and the Alumni Career Advisory Network, students both on and off campus can log onto CUINFO.

Advanced Professional Degrees

Advanced professional-degree programs are designed to prepare participants for specific professions. The admission procedures, requirements, and curricula for such degrees are approved by the Graduate Faculty and 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 about admission or academic requirements for any professional degree may be found in the Announcement of the separate school or college in which the degree is offered. Inquiries addressed to the Graduate School will be forwarded to the proper official. The professional degrees listed below are approved by the Graduate Faculty.*

Africana Studies

Master of Professional Studies (African, Afro-American)—M.P.S.(A.A.A.) The program leading to this degree is intended to prepare students for teaching, research, and other professional careers related to Black studies. Degree requirements include thirty credits of course work (or the 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 who want to study in depth or in breadth a subject or problem that is pertinent to their profession. Graduate students interested in the M.P.S. (Agr.) degree may select from among the following fields: agricultural economics, agricultural engineering, agronomy, animal science, development sociology, floriculture and ornamental horticulture, food science, international agricultural and rural development, natural resources, plant breeding, plant pathology, plant protection, pomology, vegetable crops. Detailed information may be obtained from the Director of Instruction, 192 Roberts Hall.

Architecture, Fine Arts, City and Regional Planning

The following four degrees and joint degree program are administered by the Division of Architecture, Art

and Planning of the Graduate School. Inquiries should be addressed to the graduate faculty representative of the field in question.

Master of Architecture—M.Arch. Training is provided in architectural design and urban design. Only graduates of a professional program in architecture (the B. Arch. or its equivalent from an approved institution) are admitted as candidates. Others may be admitted as undergraduate transfers and will be required to complete additional course work before applying for admission to the degree program.

Master of Fine Arts—M.F.A. This program offers opportunity for advanced study and specialization in one of the following subject areas: graphic arts, painting, photography, or sculpture. A bachelor's degree is required, with emphasis on art history recommended.

Master of Landscape Architecture—M.L.A. Professional training is provided in the areas of landscape architectural design and land-use planning. The three-year program is open to individuals with undergraduate degrees in any area. The two-year program accepts only persons who have earned degrees in landscape architecture or in architecture. The program is sponsored jointly with the College of Agriculture and Life Sciences.

Master of Regional Planning—M.R.P. Training is provided for a professional career in the field of planning at the city, regional, or national level.

Master of Landscape Architecture and Master of Regional Planning—M.L.A. and M.R.P. This joint degree program, which allows students to earn both the Master of Landscape Architecture and the Master of Regional Planning degree, provides an opportunity for an increased educational experience in two related professional fields. Students should apply to both programs for admission, indicating their interest in the joint program.

Communication Arts

Master of Professional Studies (Communication Arts)—M.P.S.(C.A.) This program is primarily concerned with communication planning. It concentrates 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 want to work with agencies in which organized public or employee 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. Detailed information may be obtained from the graduate faculty representative.

Education

Master of Arts in Teaching—M.A.T. This program is designed for, and limited to, those preparing to teach agriculture or home economics in secondary schools. The student and the Special Committee select courses

*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 about these degrees, address the school or college indicated.

Master of Business Administration: Johnson Graduate School of Management
 Doctor of Law: Law School
 Doctor of Medicine: Medical College, New York City
 Doctor of Veterinary Medicine: New York State College of Veterinary Medicine

and seminars in the teaching specialty and in education that are appropriate for developing competence as a teacher. The student will be required to demonstrate teaching skill in a supervised field experience. Two and two-fifths residence units are required. For information about the summer-option M.A.T., write to the graduate faculty representative.

Engineering

Master of Engineering—M.Eng. Eleven, one-year designated master's degrees are awarded through the Engineering Division of the Graduate School: M.Eng. (Aerospace), M.Eng. (Agricultural), M.Eng. (Chemical), M.Eng. (Computer Science), M.Eng. (Electrical), M.Eng. (Engineering Physics), M.Eng. (Materials), M.Eng. (Mechanical), M.Eng. (Nuclear), M.Eng. (Operations Research and Industrial Engineering).

A twelfth curriculum, in Manufacturing Systems, leads to a Master of Engineering degree that may be designed as M.Eng. (Chemical), M.Eng. (Electrical), M.Eng. (Mechanical), or M.Eng. (OR&IE).

Cornell applicants who are seniors in engineering and in the upper half of their class are usually admitted to an M.Eng. program; outside applicants are admitted on the basis of their undergraduate preparation and performance. A baccalaureate degree is required, but there is an early admission policy for exceptional applicants who, at the time of matriculation, will be eight or fewer credits short of a baccalaureate degree.

The requirements for the M.Eng. degrees include a minimum grade-point average of 2.5 and completion of thirty credits of graduate-level technical courses. Included in the thirty credits is work on an engineering design project.

Limited financial aid in the form of merit-based fellowships, company internships, and teaching stipends is available. Students who apply to the program by November 1 will be notified of financial-aid offers by December 15. The regular deadline for financial-aid application is February 1; applicants receive notification by April 1 and must respond by April 15.

Further information about the M.Eng. programs may be obtained from the Graduate Professional Programs Committee Office, 109 Hollister Hall.

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 for this purpose.

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 W. K. Jordan, 106 Stocking Hall.

Master of Professional Studies—M.P.S.(Agr.)

This program in agriculture offers graduate curricula for candidates whose interests may not be oriented toward research and who want preparation for careers in food-processing industries, educational institutions, government, and international agencies. Further information may be obtained from Professor W. K. Jordan, 106 Stocking Hall.

Hotel Administration

Master of Professional Studies (Hotel Administration)—M.P.S.(H.Ad.) This degree is available to students with bachelor's degrees in all academic areas, including hotel administration. The program allows students with hospitality-related work experience to pursue academic study on a more professionally oriented, less research-inclined level than that of the M.S. The mode and curriculum for completing the program vary according to areas previously studied. For further information see p. 67 or write to the Graduate Office, 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 need further academic training but whose career goals are not oriented to research and teaching at an advanced level. Applicants may apply for the M.P.S. (Hu.Ec.) degree through the Fields of Design and Environmental Analysis, Human Development and Family Studies, Human Service Studies, or Nutrition. Degree requirements include a minimum of two residence units (one of which must be earned in a semester during the academic year) and completion of thirty credits, including a problem-solving project. The Sloan Program in Health Services Administration is a two-year curriculum leading to the M.P.S. (Hu.Ec.); sixty hours of course work are required. Detailed information may be obtained from the Office of the Associate Dean, N115A Martha Van Rensselaer Hall.

Industrial and Labor Relations

Master of Industrial and Labor Relations—M.I.L.R.

The 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. Normally completed in two years, this degree program is administered by the Division of Industrial and Labor Relations of the Graduate School. Students possessing a law degree may be eligible for a one-year M.I.L.R. program. More information may be obtained by writing to the Graduate Office, School of Industrial and Labor Relations, Ives Hall.

Master of Science in Industrial and Labor

Relations—M.S.I.L.R. This degree provides the opportunity for persons in the New York metropolitan area to pursue professional graduate study while continuing their daytime employment. It is offered in

conjunction with the Bernard M. Baruch College of City University of New York.

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 substantive and analytic skills in areas of specific relevance to their professional careers. The course of study consists of two and two-fifths residence units and at least thirty credits, including an applied research project. Ordinarily students will divide their course work between areas 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, population, planning, and science and technology policy. Further information is found on p. 20, and a descriptive brochure may 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 want 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 wants to become a proficient scholar through 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. The D.M.A. is awarded in two concentrations: musical composition, and eighteenth-century performance practice; the M.F.A. is awarded in composition only. These degrees are designed for composers, and for performers specializing in eighteenth-century literature on authentic instruments, who seek further professional training to enrich their creative perspectives and to prepare them for teaching music 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 the Graduate Faculty Representative, 125 Lincoln Hall.

Nutrition

Master of Nutritional Sciences—M.N.S. This program is designed to train graduate students as clinical nutritionists able to provide comprehensive nutritional care. The emphasis is on basic, clinical, and investigative nutrition and on achieving interpersonal effectiveness among members of the health care team

and clients. The program requires some specific course work, six months of field experience, and a thesis. These requirements, when completed, lead to eligibility for membership in the American Dietetic Association. Admission is made through the graduate Field of Nutrition, but the degree is administered by the Division of Nutritional Sciences. Additional information may be obtained from Professor V. Utermohlen, N206A, Martha Van Rensselaer Hall.

Theatre Arts

Master of Fine Arts—M.F.A. The Master of Fine Arts in theatre arts is a terminal degree program intended for students who want advanced training to increase their competence for careers in the professional theatre. Studio-oriented programs are available for actors, combining theory and practice in intensive applied application. For further information see p. 96 or write Professor Stephen R. Cole, 212 Lincoln Hall.

Graduate School of Medical Sciences

The Graduate School of Medical Sciences offers training for individuals seeking careers in research and teaching in the biomedical sciences through advanced degree programs leading to the Ph.D. and the M.S. Full administrative responsibility for these programs is held by the Graduate School of Medical Sciences. In addition, the school collaborates with Cornell University Medical College to provide training opportunities for those wishing to pursue combined M.D./Ph.D. programs.

The Graduate School of Medical Sciences consists of two divisions on neighboring campuses in New York City: the Medical College Division, located on the campus of the Cornell University Medical College, and the Sloan-Kettering Division, located within the facilities of the adjacent Memorial Sloan-Kettering Cancer Center. Despite this divisional structure, the courses offered by the two divisions are open to all students, as are the general facilities of the divisions, such as libraries, dining halls, and recreational resources.

Fields of study at the Medical College Division include Biochemistry; Cell Biology and Genetics; Microbiology, Immunology, and Pathology; Neurobiology and Behavior; Pharmacology; Physiology and Biophysics. Areas of concentration at the Sloan-Kettering Division are Cell Biology and Genetics, Immunobiology, Developmental Therapy, and Clinical Investigation. In addition, faculty members of both divisions are offering jointly the Interdivisional Program in Molecular Biology.

Various fellowships, assistantships, and scholarships are available. Information on programs, admissions, and financial aid are provided in the school's *Announcement*, which may be obtained from the Office of the Graduate School of Medical Sciences, 1300 York Avenue, New York, New York 10021 (telephone: 212/472-5670). Additional information on the Sloan-Kettering Division may be obtained from Dr. Richard A. Rifkind, Director, Sloan-Kettering Division, Graduate School of Medical Sciences, 1275 York Avenue, New York, New York 10021.

Medical College Division

Biochemistry Research opportunities are offered in amino-acid metabolism and transport; enzyme structure, function, kinetics, and mechanism of action; design and synthesis of specific enzyme inhibitors; macromolecular interactions in membranes; cytoplasmic control of eukaryotic gene expression; RNA sequence and conformation; calcification mechanisms in bone and tooth formation; electron microscopy of macromolecules; computer simulation and numerical analysis; lipoprotein structure and function, lymphocyte activation and cell-cell interactions; and immunology of organ transplantation.

Cell Biology and Genetics Graduate study in this field emphasizes independent research in cell and developmental biology of muscle, nonmuscle and cytoskeletal systems; membrane biogenesis, epithelial polarity, and receptor analysis; chromosome structure and DNA replication; molecular genetics of early development, gametogenesis and oncogenesis; and somatic cell genetics and human inherited disorders. Methodologies include electron microscopy, monoclonal antibodies, and recombinant DNA procedures. The training program stresses interdisciplinary approaches and provides opportunities to extend basic research to a clinical setting.

Microbiology, Immunology, and Pathology Graduate students in this field pursue the study of the etiology, mechanisms of pathogenesis, and natural history of disease. Opportunities for research include structure and nucleotide sequence of viral genomes and their interaction with host chromosomes; mechanism of viral DNA replication; establishment of latent viral infections; transport of biological macromolecules across membrane barriers; protein engineering: synthesis of proteins specifically altered by genomic manipulation; anti-oxidant defense systems in malaria parasites and trypanosomes; molecular cloning and design of specific inhibitors of parasite superoxide dismutase; parasite and host factors in the experimental pathogenesis of American leishmaniasis and South American trypanosomiasis; screening and mode of action of antileishmanial compounds; immune responses to intercellular parasites; interaction between microorganisms and phagocytic cells; clinical microbiology; proliferation and differentiation of immunocompetent cells; regulation of the immune response; ontogeny and control of heterogeneity of antibody affinity; immunobiology of aging; and inflammatory responses.

Neurobiology and Behavior The field offers an integrated, multidisciplinary approach emphasizing neurochemistry, neurophysiology, and neuropsychology. Research training is available in the following areas: biochemistry of neuronal plasticity during growth and development; growth of nerve and the transport of materials in axons; de- and regeneration in the central nervous system; mechanisms governing differentiation and phenotypic expression of neurotransmitter enzymes; molecular genetics of neurotransmitter enzymes and neurospecific proteins; amino-acid and alpha-keto acid metabolism in brain; relationship of oxidative and calcium metabolism to neurotransmitter

interaction; central regulation of autonomic nervous system; positron emission tomography of the central nervous system; neurobiology and biophysics of invertebrate synaptic transmission; neuropharmacology of sedative-hypnotic drug dependence; ultrastructural studies of synaptic interactions in brain; immunocytochemistry of nervous specific proteins and peptides; neurophysiological and neuropsychological aspects of behavior.

Pharmacology Opportunities for thesis research include clinical pharmacology in renal insufficiency and in geriatrics; pharmacology of narcotic analgesics, receptor mechanisms, metabolism and clinical applications; cardiovascular pharmacology of allergic reactions; prostaglandin pharmacology in cardiovascular and endocrine functions; neuropharmacology of drug dependence and of drugs affecting neuromuscular synaptic mechanisms; prenatal and maternal pharmacology, drug dispositions, and differential drug effects; and environmental toxicology in developmental liver enzyme functions.

Physiology and Biophysics Academic and research training of graduate students in this field is available chiefly in the following areas: ion transport across epithelia and through single channels in lipid bilayers; cardiac muscle electrophysiology; renal tubular ion and water transport and its regulation; mathematical models of kidney function; renal tubular handling of proteins; atrial natriuretic factor; synaptic transmission; and axonal transport.

Sloan-Kettering Division

Cell Biology and Genetics Research in this program encompasses the areas of molecular genetics, cytogenetics, somatic cell genetics, and developmental cell biology, including endocrinology. These studies employ the most modern cellular biologic, genetic, molecular biologic, and immunologic methodologies and are aimed at understanding cellular and molecular mechanisms that control coordinated gene expression and cell proliferation during induced cell differentiation; changes in DNA and chromatin structure that accompany cell differentiation; regulatory interactions involved in the proliferation and differentiation of normal and neoplastic hematopoietic and lymphoid cells; regulation of cell growth and function by extracellular agents such as peptide hormones, growth factors, and neurotransmitters; and genetic control of both normal and abnormal cell differentiation during embryogenesis.

Immunobiology This program comprises the development, general properties, function, and regulation of the cellular components of the immune response, as well as of the secreted products of the cells. The program's research is in three main areas: (1) immunogenetics, especially the cell-surface determinants involved in the differentiation and function of normal and malignant lymphoid cells; (2) cellular immunology and immunoregulation, especially the cellular interactions and soluble factors that are required for effective immune responses; and (3) tumor immunology, particularly the analysis of the immunological properties of the transformed cancer

cells and the interactions between tumor and host, aimed at designing possible diagnostic or therapeutic strategies.

Developmental Therapy and Clinical Investigation

This field of graduate study offers opportunities in organic chemistry, basic pharmacology, radiochemistry and radiation biophysics, neuro-oncology, endocrinology, and cellular communication biology.

Interdivisional Program in Molecular Biology

This program brings together faculty from both the Medical College and Sloan-Kettering Divisions who share a common research interest in molecular biology. This expanded faculty gives the student a broad spectrum of research opportunities to choose from and provides access to new and improved courses. Research interests of the faculty include mechanisms of viral tumorigenesis, mechanisms of action of oncogenes, growth factor receptor and growth factor action, molecular signal transduction, control of cell differentiation, prokaryotic and eukaryotic DNA replication and transcription, and the mechanisms of action of interferons.

Cornell Computer Services

Cornell Computer Services (CCS) supplies and maintains computer hardware operating systems and general and specialized programs to meet a broad spectrum of user needs. To make these resources readily accessible CCS operates a number of clusters of public terminals, provides some free consulting services, produces informative documentation, and offers a variety of user education programs. To implement computer literacy CCS is working with faculty members and teaching assistants to develop areas in which computing will enhance instruction and study.

Cornell is one of four supercomputer centers in the United States funded by the National Science Foundation. This center provides on-campus complex and large-scale computational systems for scientists, engineers, and scholars in all disciplines.

People at on-campus terminals have about 125 interactive terminals and microcomputers and small minicomputers hooked into networks to use. They may communicate with a VAX 750, a DEC-2060, and large-scale IBM computers. Specialized facilities include two Floating Point Systems attached array processors, which are very fast and highly cost-effective for long calculations, and a graphics terminal area in Uris Hall.

Graduate students may receive free distribution accounts of \$50 a week for access to the DEC-2060 and the IBM computers. A graduate student who is currently enrolled and in the process of writing a thesis may receive \$150 a week toward the text processing needs of writing a thesis (CUTHESIS). CUTHESIS is a superset of the text-processing language SCRIPT, which formats a thesis in the form required by the Graduate School. CUTHESIS is used in conjunction with an on-line editor, which simplifies the process of revising a thesis.

Cornell is connected to Telenet and TYMNET, data communication networks that provide access to computing facilities in forty states as well as Mexico, Canada, and parts of Europe. As a member-supplier of EDUNET Cornell shares computer research with other institutions of higher learning. Cornell is also a member of BITNET and MAILNET, providing two-way electronic mail service between Cornell and other universities.

Computer users can gain access to the IBM and DEC computers from major public terminal clusters, including the new microcomputer facilities, on campus. Interactive terminal facilities are in Riley-Robb Hall for the College of Agricultural and Life Sciences and in Ives Hall for the School of Industrial and Labor Relations. More public terminals and clusters are planned, including facilities for housing units.

CCS consultants keep scheduled hours at Uris and Warren terminals to assist in the development of computer programs with particular emphasis on problems specific to computing at Cornell. Also, CCS staff members at Uris and Warren halls provide professional assistance for instructional computing, physical science applications, and statistical computing.

For further information, contact Cornell Computer Services, User Support Office, G20 Uris Hall.

Cornell University Libraries

The University 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 nearly five million, and that figure increases by about 120,000 each year. An unusually rich collection of reference works, both modern and antiquarian, expedites daily study and dissertational research. About 55,000 journal and periodical titles are available, most of them in complete runs, some of them in multiple copies. 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. A graduate student may apply at the circulation desk for the use of a cart to facilitate completion of his or her dissertation.

Olin has 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 East Asia, the Echols Collection on Southeast Asia, and the Fiske Icelandic Collection. Notable in the History of Science collections are the Adelman Library of Embryology and Anatomy and the library of the French scientist Lavoisier. The Department of Manuscripts and University Archives is a repository with total holdings of more than twenty-one million items. These manuscripts relate to all aspects of the economic, political, and social history of this region and the areas historically connected with it. In addition to the collections in Olin Library, many of the college and department libraries also contain materials unique in their fields. Curators and reference librarians are available for counsel concerning the availability and use of research materials.

In addition to Olin Library, the Cornell University library system comprises Uris Library, an open-stack library for undergraduates; the Albert R. Mann Library of Agriculture and Life Sciences and Human Ecology, which includes the Division of Biological Sciences; and the libraries of the following colleges, schools, and departments: Fine Arts, Graduate School of Management, Engineering, Hotel Administration, Industrial and Labor Relations, Law, Medicine (in New York City), Veterinary Medicine, Entomology, Mathematics, Music, and Physical Sciences. Added to these are the libraries of academic divisions and departments and 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 the graduate level. There are more than twenty formal programs of teaching and research on specific world regions or problem areas.

Students may develop majors or minors in various aspects of international studies through the different colleges, schools, departments, and fields in which they are enrolled and through participation in the various programs. Many students, who major 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 students to work in particular facets of international studies.

Center for International Studies

Davydd J. Greenwood, director
 Elisabeth M. Thorn, administrative manager

The Center for International Studies (170 Uris Hall) is a University unit dedicated to the support and development of Cornell's international and comparative programs. Serving as an administrative base and coordinating unit for programs, the center is particularly committed to the development of multidisciplinary, intercollege educational and research activities.

Area and Topical Programs

The following are affiliated with the Center for International Studies:

China-Japan Program; Committee on Soviet Studies; Latin American Studies Program; South Asia Program; Southeast Asia Program; Western Societies Program; Comparative Studies in Professionalism and Professional Education; International Agriculture Program; International Ethnicity; International Legal Studies; International Medicine; International Political Economy; International Population Program; International Studies in Planning; Peace Studies Program; Program in International Nutrition; Rural Development Committee.

Academic programs coordinated by the Center

Cornell Abroad Arch Dotson, director; Ann Roscoe, executive staff assistant. One major function of the center is the university-wide coordination of foreign study experiences for undergraduate students in all colleges. Programs being developed currently include study abroad opportunities in Europe and the Middle East. Cornell Abroad (Cornell-sponsored study abroad programs) begins operation in fall of 1985.

International Internship Programs Billie Jean Isbell, director. An international internship program for undergraduate and graduate students begins in summer 1985. Admission is by application only. The 1985 sites are Venezuela, Panama, and Mexico.

Master of Professional Studies in International Development Norman Uphoff, graduate faculty representative. A program designed for midlevel practitioners is sponsored by the center leading to a Master of Professional Studies in International Development degree. Interested individuals should apply through the Graduate School.

China-Japan Program

This program provides comprehensive graduate-level training and sponsors a wide range of research. Graduate students in the program take a major in such fields as agricultural economics, Asian studies, anthropology, development sociology, economics, government, history, history of art, linguistics, or literature. Early mastery of the Chinese or Japanese language that is sufficient to permit use of Chinese or Japanese sources in courses and seminars and in research is expected. Fellowships are available to some students in the program.

The focus of much of the research and teaching in the program is the culture, economy, history, and society of traditional and contemporary China and Japan. Recent research supported by the China-Japan Program

includes ancient and contemporary Chinese relations with Southeast Asia; center-regional relationships in traditional and modern China; Chinese agriculture; Chinese and Japanese economic relations; classical and early modern Chinese and Japanese literature; contemporary Chinese and Japanese international relations; cultural-religious practices of the China-Southeast Asia border regions; Japanese and Chinese linguistics; Japanese performing arts; and the religions and societies of Japan and China.

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.

International Agriculture Program

The International Agriculture Program provides opportunities for graduate-level study and research on agricultural and rural development in developing nations. A minor in the Field of International Agricultural and Rural Development is offered for the M.S. and Ph.D. Persons with experience or those employed in developing countries who desire a broad graduate program not oriented toward a discipline may apply for the Master of Professional Studies (M.P.S.) in this field. Students may take courses that 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 special problems of newly developing countries. There are opportunities to draw upon the strong international programs in various colleges of the University, including the area study programs and the offerings in modern languages.

Additional information may be obtained by writing to the Director, International Agriculture Program, 261 Roberts Hall.

International and Comparative Labor Relations

This area of study deals with two major problems: a comparative analysis of the ways in which Western industrial societies deal with labor relations problems, and an examination of labor policies and institutions in non-Western societies. An opportunity is also afforded to study the history of major European labor movements and to examine special topics in international labor affairs.

Further information may be obtained by writing to John P. Windmuller, Director, International and Comparative Labor Relations Program, 296 Ives Hall.

International Legal Studies Program

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 and conferences on comparative and international legal topics, and a program of speakers and seminars open to students.

For more detailed information, see the *Announcement of the Law School* or write to Professor John J. Barceló III, Chairperson, Graduate Study Committee, Cornell Law School.

International Nutrition Program

This program provides graduate-level training for those concerned about nutrition problems in low-income countries. International nutrition is one of the concentrations available to students working toward a Ph.D. or M.S. in the Field of Nutrition. It is also one of the concentrations available for the Master of Professional Studies (International Development) degree. A number of persons from fields such as Food Science or Agricultural Economics minor in international nutrition. Others spend time in the program as postdoctoral fellows, as special or non-degree students, or as visiting fellows.

The International Nutrition Program is intended for foreign students who will be undertaking nutrition work in their own countries and American students who are interested in careers in international nutrition. There is an increased recognition of world food and nutrition problems, the complexity of their etiology, and the multidisciplinary approach needed for their solution. The Cornell approach is perhaps unique in its attempt to address these issues in a program that includes broad training, research in several parts of the world, and service to international agencies and to Third World countries.

Further information may be obtained from Professor Michael C. Latham, Director, International Nutrition Program, Division of Nutritional Sciences, 127 Savage Hall.

International Population Program

At the graduate level, this program stresses the relation of social and cultural factors affecting fertility, mortality, migration, and urbanization in various parts of the world. Teaching in the program also includes demographic techniques and theory, ecology, family planning, health and medicine, and population policy.

A Ph.D. candidate can have population studies as a major or minor area of concentration. An M.A. candidate in the program usually minors in population studies and majors in general sociology. Admission as a Ph.D. candidate or as an M.A. candidate with population studies as the area of concentration 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) degree.

Further information may be obtained from the International Population Program, 372 Uris Hall.

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, and relevant data is applied from various fields.

Building on more than twenty years experience in the Andean region, program members are currently involved there in research that includes the disciplinary perspectives of anthropology, archaeology, economics, linguistics, and sociology.

Research on the unique situation in Brazil is currently being carried out by a number of investigators in agriculture, economics, history, and sociology.

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

Graduate students are encouraged to join faculty 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 Social Science Research Council, the Fletcher School of Law and Diplomacy, Fulbright-Hays, the Doherty Foundation, the Inter-American Foundation, and the Organization of American States.

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

Peace Studies Program

The Peace Studies Program sponsors teaching and research on the moderation or avoidance of war and on the political, economic, technical, and social implications of progress toward peace. In graduate teaching and research, the program emphasizes an interdisciplinary approach involving social scientists, natural scientists, engineers, and lawyers. There is a graduate minor field of Peace Studies and Peace Science for students who want to establish competence in these fields. Students are encouraged to participate in the colloquia, research, and publication activity sponsored by the program. Student fellowship and research resources are available.

Further information may be obtained from the Director, Peace Studies Program, 180 Uris Hall.

Program in International Education

The objective of the Program in International Education is to add an international dimension to the College of Human Ecology curriculum by enlarging course content and offerings and increasing faculty expertise and student participation. To this end the program facilitates the academic exchange of U.S. and foreign

students and scholars, supports increased international content in departmental and interdisciplinary course offerings and provides orientation for students studying or doing fieldwork abroad. The core course, Preparation for Intercultural-International Study, enables students to develop the skills necessary for effective intercultural-international interaction and to become oriented to the nations, regions, and cultures in which they intend to work and study.

For further information, contact Kathleen Rhodes, International Education Program, N135 Martha Van Rensselaer Hall.

Program on International Studies in Planning

The Program on International Studies in Planning supports teaching and research on regional and urban issues; emphasis is placed on problems of regional underdevelopment and urban growth. Population shifts in the balance of the urban and rural sectors, the rapid expansion of cities and attendant in-migration, and differences and inequities between subnational regions are areas of special concern.

For further information, contact Professor William W. Goldsmith, City and Regional Planning, 200 West Sibley 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.

The Program on Participation and Labor-Managed Systems was established in 1970 to conduct theoretical and empirical research on the theory, practice, and implementation of self-management and to sponsor course offerings, workshops, and conferences. Two or three courses are offered each year in this area by the Department of Economics. In addition, there are guest lecturers and an occasional course in cooperation with other schools and departments.

Extensive cross-disciplinary cooperation has been developed with other schools and departments at Cornell, such as the College of Agriculture and Life Sciences, the Graduate School of Management, the School of Industrial and Labor Relations, and the Departments of City and Regional Planning, Education, Government, and Rural Sociology. Faculty from most of these areas are represented on the Executive Committee of the program.

A documentation center to serve as a resource in the area of participation and labor-managed systems is available under the auspices of the program.

For further information, contact the Director, Program on Participation and Labor-Managed Systems, 490 Uris Hall.

Rural Development

Although there is no formal major or minor in rural development, students can select faculty interested in rural development to serve on their Special Committee. Interested students may choose to work on rural development issues by selecting the Fields of Public Policy or International Agricultural and Rural Development as minors complementing their major fields. Students who want to do professional studies on particular aspects of rural development can work for a Master of Professional Studies degree in Agriculture or in International Development. The Rural Development Committee brings together Cornell's strengths in this interdisciplinary area by supporting a program of research, publication, guest speakers, and scholars in residence.

Further information may be obtained from Professor Norman Uphoff, Rural Development Committee, 170 Uris Hall.

South Asia Program

The South Asia Program encompasses the study of Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka (Ceylon). 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 one of the countries of the area. 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 includes a long-term project primarily concerned with agricultural development and its ramifications in India and projects on the palaeoanthropology of the subcontinent of India and Sri Lanka and on religion and cultural change. Other studies involve rural development and communications. Several studies are being conducted on languages of the area, including a special study of the Sinhala language and linguistics 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 Resource Fellowships are open to incoming graduate students. Opportunities for field research and advanced language study are available through the American Institute of Indian Studies (AIIIS), of which Cornell is a class A member. 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.

Southeast Asia Program

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 areas 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 Resource Fellowships; and, for advanced Ph.D. candidates, Fulbright-Hays-funded Doctoral Dissertation Research Fellowships, and International Dissertation Research Fellowships administered by the Social Science Research Council.

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 specializations: Russian history, Russian literature, Slavic linguistics. Other subjects combine area specialization within a wider framework: comparative government, economic planning, history of architecture, music, 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 Olin Library, major reference works and key current periodicals from and about the USSR are brought together.

Inquiries about fellowships and other aspects of Soviet studies should be addressed to the Chairperson, Committee on Soviet Studies, 140A Uris Hall.

Western Societies Program

The main interests of the Western Societies Program are the historical and contemporary development of the major Western European countries, although similar developments in North America and Japan are sometimes included. The program is basically interested in the problems of the advanced industrial state, including major comparative studies of the policy process and problems of central-local relations in modern Europe. A second major interest is the historical and intellectual development of European society; emphasis is placed on the social and economic crises involved in the transition to modern democratic government. The program is also interested in both the internal and international patterns of interdependence that shape Western European politics.

The Western Societies Program includes faculty from the social sciences, history, industrial relations, public administration, and urban and regional planning. It is administered by an executive committee drawn from these departments. The program provides a limited number of pre-dissertation grants and regularly sponsors lectures and seminars by European and North American scholars. Students are welcome in the regularly scheduled seminars and workshops; the topics change from time to time. The program can also provide information on fellowships and assistance for graduate students interested in research abroad. There is also a series of occasional papers dealing with new avenues of research and new perspectives on Europe.

Additional information may be obtained from Professor Steven Kaplan, Western Societies Program, 130 Uris Hall.

Other Programs and Resources

Africana Studies and Research Center

The Africana Studies and Research Center offers instruction in African and Afro-American studies. It maintains a library of several thousand volumes on most of the African continent and on the African diaspora, especially in the New World. Special lectures, seminars, and presentations during the academic year inform students about issues and methods for studying different aspects of Africa and the African diaspora.

The graduate program affords an opportunity for structuring a course of study to meet the specific interest of its own students as well as students from other fields who select a minor concentration in either African or Afro-American studies. Its multidisciplinary and comparative focus helps students better understand the heritage and role of Africa and peoples of African ancestry.

Additional information may be obtained from the Africana Studies and Research Center, 310 Triphammer Road, Ithaca, New York 14850-2599.

American Studies

Although there is no formal program leading to a degree in American studies, candidates for the doctorate in English or history will find ample opportunity to do interdisciplinary work in conjunction with a concentration 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. 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 Professor Cushing Strout, American Studies Committee, Department of English, Goldwin Smith Hall, or to Professor Richard Polenbergh, Department of History, McGraw Hall.

Division of Biological Sciences

Established in 1964, the Division of Biological Sciences brings together investigators and teachers representing a broad spectrum of interests in basic biology. The division has the primary responsibility for research and undergraduate education in basic biology. Its faculty members, as members of various graduate fields, provide opportunities for graduate study in biochemistry, molecular and cell biology; botany; ecology and evolutionary biology; genetics; neurobiology and behavior; physiology; or zoology. The division is organized into the Sections of Biochemistry, Molecular and Cell Biology; Ecology and Systematics; Genetics and Development; Neurobiology and Behavior; Physiology; and Plant Biology. A number of fellowships, assistantships, and traineeships are available.

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

Biophysics Program

Biophysics appears in many departments and graduate fields at Cornell. There is no single department or field of biophysics; biophysics research and study at the graduate level are carried on as a part of the programs of various fields, including Applied Mathematics; Applied Physics; Biochemistry, Molecular and Cell Biology; Botany; Chemical Engineering; Chemistry; Electrical Engineering; Materials Science and Engineering; Mechanical Engineering; Neurobiology and Behavior; Physics; Physiology; and Theoretical and Applied Mechanics. The Biophysics Advisory Committee, which sponsors various joint activities, can provide information and guidance in selection of the graduate field.

The diversity of biophysical interests and affiliations among the faculty makes biophysics accessible through many fields, particularly since choice of the thesis research subject and supervisor may transcend field membership. The special committee system of

supervision of graduate study is particularly amenable to an interdisciplinary area such as biophysics, but because there is such a diversity, prospective students should choose carefully the field to which they apply, according to interests and background preparation.

Courses that include biophysics appear in the offerings of various departments. A brochure containing available courses and program descriptions can be obtained from the Program in Biophysics, 210 Clark Hall.

Faculty involved in research with a biophysical orientation are listed below.

- B. A. Baird (chemistry): molecular aspects of cell-membrane receptor proteins important in immunological responses
- R. R. Capranica (electrical engineering, neurobiology and behavior): mechanisms of frequency analysis in the inner ear; neural mechanisms underlying sound communication
- S. J. Edelstein (biochemistry): analytical ultracentrifugation; cooperative interactions and assembly of supramolecular structures; electron microscopy and image reconstruction
- G. W. Feigenson (biochemistry): NMR spectroscopy; protein-lipid interaction in membrane systems
- D. B. Fitchen (physics): laser Raman studies of heme protein conformation
- Q. H. Gibson (biochemistry): mechanism of action of hemoglobin; stopped-flow reaction kinetics
- G. G. Hammes (biochemistry, chemistry): mechanism of enzyme regulation and catalysis; nanosecond fluorimetry; rapid-reaction kinetics; thermodynamic, kinetic, and structural studies
- G. P. Hess (biochemistry): chemical reactions in the transmission of nerve impulses; enzyme kinetics
- P. C. Hinkle (biochemistry): measurement of pH gradients; membrane transport and chemiosmotic coupling
- A. Jagendorf (botany): biosynthesis of chloroplast proteins; photophosphorylation
- S. A. Levin (applied mathematics, ecology and evolutionary biology): ecology and population dynamics; mathematical biology; mathematical ecology
- A. Lewis (applied physics): laser probes of the molecular basis of vision and light energy conversion
- R. E. McCarty (biochemistry): measurement of pH gradients; structure and function of chloroplast membranes
- J. K. Moffat (applied physics, biochemistry): structure and function of hemoglobin and calcium-binding protein; X-ray crystallography
- T. R. Podleski (neurobiology and behavior): differentiation of muscle cells in culture
- M. M. Salpeter (applied physics, neurobiology and behavior): electron microscopic investigations of neural function; quantitative electron microscope autoradiography of trophic and excitable tissue
- H. A. Scheraga (chemistry): protein structure and function
- B. M. Siegel (applied physics): high-resolution electron microscopy of biological structures
- R. M. Spanswick (applied physics, botany): biophysical studies of ion transport in plants

R. H. Wasserman (physiology): membrane transport; transport of mineral ions across epithelial membranes

W. W. Webb (applied physics, physics): biophysical cell processes; diffusion on cell membranes; fluorescence correlation spectroscopy; membrane and enzyme dynamics

Brookhaven National Laboratory and Fermi National Accelerator Laboratory

Cornell is one of nine eastern universities participating in Associated Universities, Inc. (AUI). Operating under contract with the Department of Energy, 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.

Cornell is also a member of Universities Research Association, Inc., which operates the Fermi National Accelerator Laboratory at Batavia, Illinois, where a 1,000-GeV proton synchrotron and a 1,000 GeV proton on 1,000 GeV antiproton collider are in operation. Several groups of Cornell physics staff are participating in work on this new frontier of elementary particle physics.

Graduate students may participate in research at the Brookhaven or Fermi laboratory by association with Cornell staff members who are engaged in research at these laboratories. Both laboratories also offer temporary summer appointments to a limited number of selected graduate and undergraduate students in science or engineering.

Computer-aided Design Instructional Facility

When CADIF was established in 1979, the use of computer graphics and computer-aided design in engineering research and industry had just begun. It was foreseen that computer graphic tools and techniques would allow great advances in engineering research and practice and that they would be in almost universal use within a few years. CADIF was one of the first facilities to provide instruction in engineering principles using computer graphics, in computer-aided engineering design, and in the techniques of graphics programming itself. It has continued to do so as the growth in this field has met and surpassed those early predictions.

Today CADIF is used by over 1,500 students each year in more than thirty courses from freshman to graduate level, as well as in program development and research. Every field in engineering is represented: mechanical, structural, electrical, chemical, and environmental engineering; basic studies; mathematics; geology; operations research; and computer science. Many educational programs have been developed and used here, allowing the illustration of concepts and the assignment of problems that would not be possible otherwise. In particular, students have unique opportunities to study problems on a realistic scale and

complete individual and small-group design and programming projects using the same kind of tools that professionals in their field do. CADIF has also provided a natural path for incorporating recent research findings into the curriculum, thereby guaranteeing up-to-date, high-quality instruction.

CADIF is committed to providing a state-of-the-art environment for graphic and interactive computing. Current facilities include two VAX computers supporting twelve graphic displays (six high-speed, high-resolution vector refresh units and six full-color displays) plus a large number of editing terminals. A full set of software tools for program development in any of several languages, and for document preparation, is provided. Present plans also call for the addition of a number of high- and medium-performance graphic workstations in the near future to meet the continually increasing demand for this kind of computing.

Program of Computer Graphics

The Program of Computer Graphics is an interdisciplinary graphics center dedicated to the development of interactive graphics techniques and the uses of the techniques in a variety of applications. The center was initially established in 1974, primarily through a large National Science Foundation grant. Since its inception, collaborative research has been conducted in diverse areas. Projects have included the domains of architecture, computer science, cartoon animation, graphics research, energy conservation, medicine, and structural engineering. The computer graphics facility is one of the most advanced laboratories in the United States and provides a unique opportunity for interdisciplinary research in computer-aided design.

Primary research involved the development of graphic input techniques and graphic display techniques. A number of input methods have been implemented, all based on the use of digitizing tables. The display routines range from standard black and white vector displays for static or dynamic images to full-color displays. All objects can be displayed in full perspective with hidden surfaces removed. Unique hidden-surface algorithms have been developed to allow both vector and raster graphic applications to use the same routines. Specular and diffuse reflectance, transparency, refraction, and smooth-shading routines are operational.

Graphics research topics that have been under investigation include realistic image synthesis, polygon clipping hidden surface algorithms, spatial and temporal aliasing problems, geometric modeling, the effect of parallel processing systems on the performance of image generation algorithms, and color. The latter includes studies of appropriate color spaces, the minimum band-width transformations from RGB to YIQ space, equal perceptual space, and the use of pseudocolor for representing fourth- and fifth-dimensional information.

The most appropriate way to study and do research in computer graphics is to enter the Master of Science program with a major in architectural science and a minor in computer science. The course work would primarily consist of courses in the computer science

department, to be jointly determined by the student and his or her minor adviser. The research and thesis would consist entirely of work performed in the computer graphics laboratory. For those students wanting to study the relationship of computer graphics to an application field (e.g., architecture, engineering), the minor is usually in the most closely related subject area.

Additional information may be obtained from Donald Greenberg, Director, Program of Computer Graphics, 120 Rand Hall.

Center for Environmental Research

The Center for Environmental Research (CER) serves all segments of the University. It promotes and coordinates a comprehensive program of interdisciplinary research, teaching, and public service activities relating to environmental topics. CER's four major programs are (1) ecosystems research, conducted and coordinated by the Ecosystems Research Center, an EPA/Cornell-funded center whose ecosystems orientation and expertise support EPA's regulatory activities; (2) teaching, research, and extension activities conducted by the Cornell Laboratory for Environmental Applications of Remote Sensing; (3) research and seminars conducted by the Environmental Law and Policy program, focusing on risk perception and management and regulation of toxic substances; and (4) water resources research and public service activities conducted by the Water Resources Program and as New York State's water resources research institute.

In addition, the center publishes *Environmental Update*, a quarterly publication on environmental research and activities at Cornell, and *Synopsis*, a series of monographs on water quality management topics. CER also conducts seminars and symposiums in all of the four major program areas listed above.

Correspondence concerning the center should be sent to Neil Orloff, Director, Center for Environmental Research, Hollister Hall.

Cornell High Energy Synchrotron Source

CHESS, the Cornell High Energy Synchrotron Source, is a national laboratory supported by the National Science Foundation to provide high energy X radiation for studies in the physical and biological sciences. CHESS utilizes synchrotron radiation from the Cornell Electron Storage Ring (CESR), which is used for studies in high energy particle physics. Radiation from the storage ring is channeled through three beam lines that are then split to provide six experimental stations. Users of the facility range throughout all fields of science. Approximately 100 user groups come to CHESS for studies. About one-third of these are from the Cornell community and the rest are from other universities, industries, and national laboratories.

The X radiation from CHESS is unique in its time structure and the high X-ray energies made available.

Further information may be obtained from B. W. Batterman, Director, CHESS, Clark Hall.

Cornell Institute for Social and Economic Research

The Cornell Institute for Social and Economic Research (CISER) is a cross-disciplinary organization of more than two hundred Cornell social science faculty members seeking to enhance the environment for social science research at the University and to provide a focus and a voice for Cornell social researchers. CISER develops and maintains programs of research, and the institute's staff are available to assist researchers with their projects.

Two formal research programs are currently administered through CISER. Analyses of Comparative Social and Economic Systems and New York State (ACSES-NY) emphasizes policy-applicable social and economic models bearing on New York State. Other research objectives for that program include improved methods of computer-based analyses and the development of better access to state data. The Program in Urban and Regional Studies (PURS) focuses on the spatial distribution of populations and their activities at the subnational and national level. Currently under consideration is a third CISER program emphasizing survey research and analysis.

The institute's research support services include a data archive, an important component of the institute. The CISER data archive provides access to a major collection of machine-readable data files that contain demographic, economic, and international statistics, social surveys, and small-area socioeconomic data. Services include large-scale data file acquisition, maintenance and processing, and liaison with major data archives, data distributors, and government agencies. A professional staff of information specialists gives support and instruction to researchers in locating, acquiring, and using data resources.

The CISER Survey Research Facility offers an integrated set of services for all phases of survey research: questionnaire design, sampling, data collection, data coding, and data entry and analysis. Staff conduct opinion polls on public policy issues relevant to state and local decision makers, as well as demographic and behavioral surveys in New York State to update and enrich data available from federal and state sources. Clients may contract for special analyses from these surveys, to add "riders" to survey questionnaires, and to conduct special surveys.

CISER provides a number of other services in support of social science research. The New York State Information System is a program of research assistance and data-base development specializing in social, economic, and demographic data of New York State. A skilled staff of technical consultants provide computing support for research, using mainframe and microcomputers and machine-readable statistical resources. CISER offers special seminars and workshops, aids faculty in the preparation of research proposals, and assists in the development of research interest groups, both substantive and methodological. The institute, in cooperation with Cornell Computer Services, maintains two computing facilities for social science research. CISER publications include the *CISER Directory of Cornell Social Scientists and Economists*, which describes the research interests of

more than four hundred faculty members; *SyntheCISER*, a newsletter for campus social scientists; and *Social Science at Cornell*, a biweekly listing of campus events of interest to Cornell social scientists.

Further information may be obtained by writing to the Director, CISER, 323 Uris Hall.

Institute for Comparative and Environmental Toxicology

The Institute for Comparative and Environmental Toxicology (ICET) provides an opportunity for participation in collaborative research efforts in comparative and environmental toxicology. It facilitates the flow of information between researchers conducting independent investigations in toxicology and informs them of emerging opportunities and support for research. In addition, the institute provides administrative support for the Field of Environmental Toxicology and assists in developing teaching programs in toxicology. It maintains a service program, preparing advisory bulletins and other educational materials for the general public and government agencies. Finally, the institute is instrumental in devising policies for the safe use of toxic chemicals on the campus.

Further information is available from C. F. Wilkinson, Director, N202 Martha Van Rensselaer Hall.

Materials Science Center

The Materials Science Center (MSC) is an interdisciplinary program created to promote research and graduate student training in all phases of the science of materials. The subjects of research investigation in the MSC program are mechanical properties, optical phenomena, phase transitions, low-temperature phenomena, and surfaces and interfaces.

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 fifteen central technical facilities operated by the center are available to provide access to sophisticated major equipment such as crystal-growing furnaces, electron microscopes, computers, and X-ray apparatus. The technical staff in each facility give advice on use of the equipment, assist with routine measurements, and are continually developing the technology of their particular area.

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

National Research and Resource Facility for Submicron Structures

The National Research and Resource Facility for Submicron Structures (NRRFSS) was established at Cornell in 1977 by the National Science Foundation (NSF) to serve as a research and resource facility for scientists in university, government, and industrial laboratories across the country.

Funding by NSF and industry enables the University to equip and operate the experimental facility, which is open to both resident and visiting scientists. The NRRFSS serves as a center for research and as a resource providing equipment and personnel services in the areas of microstructure science, engineering, and technology.

Research is carried out in four general areas: *Submicron lithography* includes the use of deep ultraviolet lithography and the development and implementation of electron, ion, and X-ray lithography. *Fabrication and growth of thin-film materials* includes molecular-beam epitaxy, e-gun and filament evaporation, thermal oxide growth, and ion-beam sputter. *Device design and fabrication* includes projects concerned with computer-aided design and layout, device and circuit modeling, and all-dry processing techniques applied to MOSFET and MESFET ICs. *Device physics and materials characterization* includes projects involving GaAs and SOS FET ICs, OPFETs, superconducting devices, and a wide variety of sensors and nanostructures, as well as characterization studies of interfaces and new thin-film materials.

Thirty-five faculty members, from eight fields and eighteen universities, cooperate in interdisciplinary studies with NRRFSS, thereby enlarging its scope and capabilities. These faculty members, as well as about ten resident staff members, are generally available to graduate students for collaboration and consultation.

Further information may be obtained from the Director, NRRFSS, Knight Laboratory.

New York State Agricultural Experiment Station at Geneva

The experiment station at Geneva, fifty miles from Ithaca, is a part of Cornell University's College of Agriculture and Life Sciences. It is one of the oldest and most prestigious agricultural experiment stations in the United States.

The mission of the experiment station is to research the production and processing of fruits and vegetables. There are sixty-six faculty members in four academic departments: Horticultural Sciences, Entomology, Plant Pathology, and Food Science and Technology. They are eligible to serve on Special Committees and to cochair the committee along with a faculty member from the Ithaca campus. Course work and research are done on the Ithaca and Geneva campuses, respectively. Transportation is provided for those who want to commute. Housing for single and married students is available on the Geneva campus. Excellent facilities are available for graduate research under laboratory, greenhouse, pilot-plant, insectary, orchard, and other field conditions.

Further information may be obtained by writing to the Director, New York State Agricultural Experiment Station, Geneva, New York 14456, or calling 315/787-2211. Students who plan to do part of their research at Geneva should correspond with the dean of the Graduate School concerning pertinent regulations.

Division of Nutritional Sciences

The Division of Nutritional Sciences is an academic unit on the Cornell campus with responsibilities for various aspects of human nutrition. Master's and doctoral degrees and the professional degrees Master of Nutritional Sciences and Master of Professional Studies (Human Ecology) are awarded through the Field of Nutrition. Professors from many disciplines provide Cornell with a strong, diversified sphere of nutritional science. Interests include community nutrition, dietetics, human nutrition, international nutrition, nutritional biochemistry, nutrition and behavior, nutrition education, and public health. 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.

Officer Education (ROTC)

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. The Army and Air Force programs offer graduate students the opportunity to earn a commission while completing their advanced degree. Graduate students are eligible to compete for two-year scholarships that include tuition, fees, books, and \$100 a month. To obtain a scholarship and commission in one of these armed services, students must complete a two-year course of study in an Officer Education program and must meet certain physical standards. On completion of requirements, students receive a commission and serve a tour of active duty in the United States Army or Air Force.

Further information is provided in the *Announcement of Officer Education*, which may be obtained by writing to Cornell University Announcements, Building 7, Research Park, Ithaca, New York 14850. Interested persons may also contact the appropriate branch of the service; each has an office in Barton Hall.

Laboratory of Plasma Studies

The Laboratory of Plasma Studies at Cornell, established in 1966, enables students and faculty members to investigate the physics of fusion and space plasma, intense electron and ion-beam physics, and laser physics on a unique interdisciplinary basis. Plasma physics plays a key role in the worldwide effort to achieve controlled thermonuclear fusion, which promises a practically limitless supply of energy. It is also of fundamental importance in understanding astrophysics and space physics. 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. The Laboratory of Plasma Studies has several constituent laboratories: the Collective Ion Acceleration Laboratory, the Ion Beam Laboratory, and the Plasma Heating Laboratory. The facilities include several pulsed-power machines, the largest of which are a 5MV 150kA machine housed in the Mitchell Street laboratory and a

2MV 500kA machine in the Ion Beam Laboratory. The laboratory has access to excellent computer facilities by dedicated telephone links to the Lawrence Livermore National Laboratory's Magnetic Fusion Energy Computing Center (MFECC) and the computing center of the National Center for Atmospheric Research (NCAR), in Boulder, Colorado. Graduate study in plasma physics is offered to students in aerospace and mechanical engineering, applied physics, astronomy, chemistry, electrical 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 the Director, Laboratory of Plasma Studies, 290 Grumman Hall.

Center for Radiophysics and Space Research

This center 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 theoretical or experimental thesis work in astronomy and astrophysics, atmospheric and ionospheric radio investigations, lunar and planetary studies, radar and radio astronomy, or space vehicle instrumentation. A student's major professor can be chosen from the following fields in the Graduate School: Aerospace Engineering, Applied Physics, Astronomy and Space Sciences, Chemistry, Electrical Engineering, Physics.

The facilities of the center include, on the Cornell campus, a laboratory for infrared astronomy (carried out from the ground, aircraft, or spacecraft) and the Laboratory for Planetary Studies; close to Ithaca are the Radio Astronomy and Ionospheric laboratories. The center has one of the six major facilities established by the National Aeronautics and Space Administration for the study of all planetary photography (the Spacecraft Planetary Imaging Facility—SPIF). Extensive collections of photographs of Mars, the moon, Venus, and Jupiter and its satellites are available, together with facilities for analysis. The collection is being augmented as new missions supply further data. 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 may conduct their thesis research while resident there.

Program on Science, Technology, and Society

The Program on Science, Technology, and Society (STS) is an interdisciplinary unit of Cornell University. Through its teaching and research the program analyzes the social issues and public-policy questions

that emerge from scientific and technological developments and expertise. Established in 1969 as one of the first programs of its kind in a leading American university, STS has since interacted productively with many similar programs. Through their research, publications, and participation in governmental and nongovernmental studies and committees, STS faculty, associates, and students have contributed to the understanding of many issues affecting modern society.

STS engages in undergraduate and graduate teaching and research coordinated with other departments, specialized centers, and related programs at Cornell. The core faculty, drawn from the physical, biological, and social sciences and from the humanities, law, and engineering, add diverse perspectives to courses, seminars, workshops, and research on STS-related topics.

The program is dynamic, adjusting its focus to the movement of broad social issues. At present, STS activities can be divided into four areas: social and political studies of science and technology; science, technology, and public policy; biology and society; and the humanistic interplay between science, technology, and society.

The STS program does not enroll students for advanced degrees. Rather, it cooperates with the various colleges to facilitate curriculum development and research interests of graduate students and faculty on the interrelations of science, technology, and society. Faculty members in the program are also members of the graduate fields of Anthropology, City and Regional Planning, Ecology and Evolutionary Biology, the various engineering fields, Environmental Toxicology, Government, Philosophy, and Sociology. A specialization in science and technology policy is available within the graduate fields of Economics, International Development, and Public Policy.

Additional information may be obtained by contacting the Program on Science, Technology, and Society, 632 Clark Hall.

Renaissance Studies

Cornell's Graduate School offers no formal degree in Renaissance studies, but because of Cornell's distinctive field system there is ample opportunity to pursue interdisciplinary work in this area. A student who wishes to concentrate upon various aspects of Renaissance culture may enter one of the Graduate School's major fields of study and with the advice of his or her Special Committee may construct an individual doctoral program that accommodates work in different disciplines. Fields with especially strong resources in Renaissance areas include Comparative Literature, English Language and Literature, Germanic Studies, History, History of Art and Archaeology, Music, and Romance Studies. Olin Library possesses internationally famous collections in Dante, Petrarch, Erasmus, the history of science, and witchcraft. Each candidate must meet the specific requirements of the field that he or she enters.

Additional information may be obtained from the graduate faculty representatives of the appropriate fields.

Members of the faculty currently involved in teaching and research on the literature, history, art, and music of the Renaissance are listed below.

B. B. Adams (English)
 A. Caputi (English)
 W. Cohen (comparative literature)
 H. Deinert (Germanic studies)
 E. G. Dotson (history of art)
 E. Fogel (English)
 S. L. Gilman (Germanic studies)
 C. Holmes (history)
 J. J. John (history)
 S. L. Kaplan (history)
 C. V. Kaske (English)
 W. J. Kennedy (comparative literature)
 M. Kubelik (architecture)
 C. Lazzaro (history of art)
 C. S. Levy (English)
 P. E. Lewis (Romance studies)
 H. S. McMillin (English)
 C. Morón-Arroyo (Romance studies)
 E. P. Morris (Romance studies)
 T. Murray (English)
 J. M. Najemy (history)
 D. Novarr (English)
 C. Otto (architecture)
 M. A. Radzinowicz (English)
 D. Randel (music)
 M. Randel (Romance studies)
 E. Santi (Romance studies)
 A. Seznec (Romance studies)
 G. Teskey (English)
 B. Tierney (history)
 N. Zaslaw (music)

Programs such as the A. D. White Professors-at-Large and the Society for the Humanities have brought to campus for extended seminars such distinguished Renaissance scholars as M. Baxandall (London), B. Bono (Michigan), E. M. Gombrich (London), S. Greenblatt (Berkeley), L. Jardine (Cambridge), J. Murdoch (Harvard), W. Ong (St. Louis), A. Patterson (Maryland), Q. Skinner (Cambridge), and D. P. Walker (London).

Society for the Humanities

The Society for the Humanities awards senior fellowships, faculty fellowships, and junior postdoctoral fellowships for research in the humanities. Fellows represent different disciplines, but their research is related to a common theme selected each year. They offer informal seminars on their current work. Details are circulated to interested departments and are listed in the *Cornell Courses of Study* catalog.

The society's seminars are open to graduate students and suitably qualified undergraduates. There are no examinations, and other requirements are at the discretion of the Fellow. Faculty members and others who are interested may attend as visitors with the permission of the instructor.

All seminars are held in the society's quarters, the Andrew D. White House, 27 East Avenue.

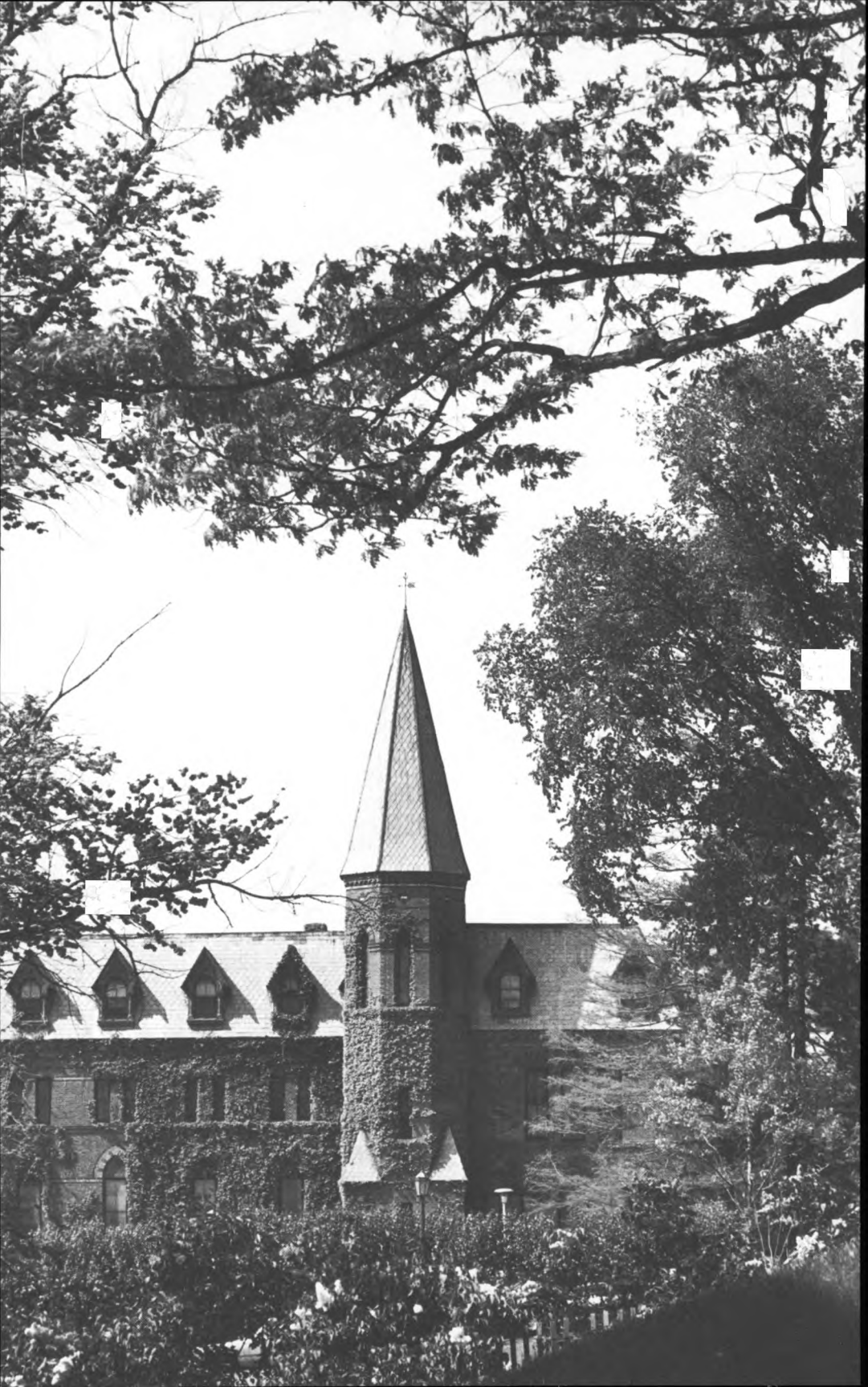
Statistics Center

The design of experiments and analysis of the resulting data are important components of research activities in many disciplines. Cornell has no single department of statistics but has well-identified groups of faculty statisticians and statistics courses in several departments of the various colleges and schools. The Statistics Center coordinates their activities and serves as a surrogate department for graduate students enrolled in the Field of Statistics. The center sponsors a weekly statistics seminar, provides information about all probability and statistics courses on campus, and administers graduate admissions to the Field of Statistics, among other activities. Professor Thomas J. Santner, 364 Upson Hall, is the director of the center.

Student Exchange Programs

The Exchange Scholar Program enables a graduate student enrolled in a doctoral program in one of the participating institutions to study at one of the other graduate schools for a limited period of time to take advantage of particular educational opportunities not available on the home campus. The academic experience, including courses taken or research conducted with particular faculty at the visited institution, is registered on the academic record maintained by the student's home institution. Participating institutions comprise the following: University of California at Berkeley, Brown University, University of Chicago, Columbia University, Cornell University, Harvard University, Massachusetts Institute of Technology, Princeton University, Stanford University, Yale University.

The Graduate School also sponsors several programs for graduate studies in universities overseas. For information on those programs contact the Dean's Office, Graduate School, Sage Graduate Center.



Cornell University

Fields of Instruction

Aerospace Engineering

Graduate Faculty Representative Z. Warhaft, 250 Upson Hall

Major and Minor Subject Aerospace Engineering

Minor Subject 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. It is recommended, but not required, that applicants submit GRE test scores.

A reading knowledge of French, German, or Russian is required of Ph.D. candidates (in addition to their native language). Ph.D. candidates may be asked to take a qualifying examination in addition to the examinations required by the Graduate School.

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 *Graduate Study in Engineering and Applied Science*.) No final comprehensive examination is required for this degree.

In the Field of Aerospace Engineering, emphasis is placed on basic aerospace sciences to prepare 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, non-Newtonian fluid mechanics, numerical methods, transonic flows, turbulence, and unsteady flows. There is also a program in combustion engine processes, plus research in chemical kinetics, plasma dynamics, and structural mechanics.

Faculty and Specializations

P. L. Auer: plasma physics; fusion power; energy policy analysis

D. A. Caughey: fluid dynamics; transonic flow; computational aerodynamics

P. C. T. de Boer: combustion processes; alternative fuels for combustion engines; high-temperature gas dynamics

A. R. George: aerodynamics; fluid dynamics; aeroacoustics; sonic boom; turbulence

F. C. Gouldin: fluid dynamics; combustion; propulsion

S. Leibovich: fluid dynamics; wave propagation; air-sea interactions; dynamics of vortex flows

G. S. S. Ludford: fluid mechanics; magnetohydrodynamics; combustion and related applied mathematics

J. L. Lumley: fluid dynamics; turbulence

F. K. Moore: fluid mechanics; turbomachinery

S. B. Pope: combustion; fluid mechanics

E. L. Resler, Jr.: high-temperature gas dynamics; pollution control; ferrofluid mechanics

S-F Shen: aerodynamics; computational fluid mechanics; polymer processing

D. G. Shepherd: fluid mechanics; turbomachinery; thermal and wind power

D. L. Turcotte: geomechanics; geophysical fluid dynamics

Z. Warhaft: experimental fluid mechanics; turbulence; micrometeorology

The regular faculty is supplemented by distinguished visitors from the United States and abroad. Visitors have included Hannes Alfvén, G. K. Batchelor, J. M. Burgers, L. F. Crabtree, Nima Geffen, Isao Imai, Theodore von Karman, S. Kitaigorodskii, J. W. Linnett, P. S. Lykoudis, F. E. Marble, R. S. B. Ong, E. R. Oxburgh, D. A. Spence, Ko Tamada, and Itiro Tani.

African and Afro-American Studies

Graduate Faculty Representative Robert L. Harris, Jr., Africana Studies and Research Center, 310 Triphammer Road

Major and Minor Subject Africana Studies

The field offers a program leading to the degree of Master of Professional Studies (African, Afro-American)—M.P.S. (A.A.A.). It is intended primarily 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. Candidates for the master's or Ph.D. degree in other fields may minor in African or Afro-American studies.

Applicants for the master's degree program are expected to have some undergraduate preparation in African or Afro-American studies. Degree candidates take a major concentration in either African or Afro-

American studies and a minor concentration in one of the areas not selected for the major or in another graduate field. After the first semester students form a Special Committee to supervise their program. A thesis proposal must be submitted at the end of the first year of graduate study. The Africana Center encourages students to develop a thesis on a range of topics based on library research, creative work, field study, or internship.

Faculty and Specializations

- W. E. Cross: Black psychology; identity, family and child development; education
 A. A. Graves: African and Caribbean literature; Francophone and Anglophone African and Caribbean literature; Afro-American writing and expression
 R. L. Harris: Afro-American history; Afro-American historiography; thought and culture; leaders and movements
 J. C. Mbata: African history; research methodology; comparative race relations; resistance movements; south African affairs
 J. Turner: Black political sociology; Black politics; social and political philosophy; racism and social analysis; Afro-American urban community development and public policy

Agricultural Economics

Graduate Faculty Representative R. Boisvert, 447 Warren Hall

Major and Minor Subjects (areas of concentration are in parentheses) Agricultural Economics (agricultural finance, applied econometrics and quantitative analysis, economics of development, farm management and production economics, marketing and food distribution, public policy analysis); Resource Economics

The field offers graduate programs leading to the Master of Professional Studies (Agriculture)—M.P.S. (Agr.), M.S., and Ph.D. degrees. Students normally are expected to obtain the M.S. or equivalent degree before entering a Ph.D. program. The M.P.S. (Agr.) is a terminal degree for persons with experience who want additional training pertinent to their profession. The M.S. and Ph.D. programs are research oriented, and each require a thesis. The Ph.D. student must take at least one minor in another field, such as Economics. To understand the breadth of theoretical and applied economics at Cornell, the student should review programs and courses in the Graduate School of Management, Department of Consumer Economics and Housing, Department of Economics, School of Industrial and Labor Relations, and Department of City and Regional Planning.

Applicants, especially those for Ph.D. or M.S./Ph.D. programs, are strongly urged to take the GREs; all applicants for University fellowships must take these examinations. An undergraduate major in agricultural economics is not required for admission, but a lack of intermediate-level economics is a deficiency that will lengthen the student's program. First-year calculus also

is important for Ph.D.-level work. Foreign applicants must take the Test of English as a Foreign Language unless their native language is English.

Application for fellowships or assistantships is made by checking the appropriate boxes on the application for admission form. Assistantships involve part-time employment in teaching or research for the Department of Agricultural Economics, and awards are made by the department. Thesis research is often conducted as a part of assistantship duties. The department also awards two fellowships annually, a Morgenthau fellowship for a person with a special interest in agricultural finance and a Crowe fellowship for a person with a special interest in college-level teaching in agricultural or resource economics. Such special interests should be mentioned in the statement of purpose.

Faculty and Specializations

- Agricultural finance: J. R. Brake, J. B. Bugliari, G. J. Conneman, Jr., E. L. LaDue, L. W. Tauer
 Applied econometrics and quantitative analysis: R. N. Boisvert, J. M. Conrad, R. A. Milligan, T. D. Mount, W. G. Tomek
 Economics of development: R. Barker, D. Blandford, D. K. Freebairn, T. T. Poleman, K. L. Robinson, D. G. Sisler, E. Thorbecke
 Farm management and production economics: J. R. Brake, G. L. Casler, G. J. Conneman, Jr., W. A. Knoblauch, E. L. LaDue, W. F. Lazarus, R. A. Milligan, B. F. Stanton, L. W. Tauer, G. B. White
 Marketing and food distribution: B. L. Anderson, R. D. Aplin, W. K. Bryant, O. D. Forker, G. A. German, D. C. Goodrich, Jr., R. B. How, W. H. Lesser, E. W. McLaughlin, A. M. Novakovic, W. G. Tomek
 Public policy analysis: D. Blandford, R. N. Boisvert, W. K. Bryant, O. D. Forker, D. R. Lee, C. K. Ranney, K. L. Robinson, D. G. Sisler, B. F. Stanton
 Resource economics: D. J. Allee, N. L. Bills, R. N. Boisvert, L. D. Chapman, J. M. Conrad, L. M. Day, R. J. Kalter, T. D. Mount, C. K. Ranney

Agricultural Engineering

Graduate Faculty Representative L. D. Albright, 206 Riley-Robb Hall

Major and Minor Subject (areas of concentration are in parentheses) Agricultural Engineering (energy, environmental engineering and waste management, food and biological engineering, handling and processing materials, international agricultural development, local roads, power and machinery, soil and water engineering, structures and their environments).

Ph.D. and M.S. Programs

An applicant to the Ph.D. or the M.S. program must have a baccalaureate degree in an area of engineering, physical science, or biological science with a strong preparation in mathematics and physics. Deficiencies in undergraduate training must be satisfied early in the advanced degree program. Applicants are strongly urged to submit scores of the GRE aptitude and advanced engineering tests.

Ph.D. candidates are required to select at least one minor subject from outside the field. M.S. candidates are required to take agricultural engineering as their major subject and select one minor outside the field. The M.S. and Ph.D. research degrees require the submission of an acceptable thesis.

Professional Degrees

The professional degree of Master of Engineering (Agricultural) is intended primarily for students who plan to enter engineering practice. Applicants for the Master of Engineering program must have a baccalaureate in engineering or its equivalent. This program is intended to develop students' backgrounds in engineering design as well as to improve their fundamental engineering knowledge. For further information, see the *Announcement Graduate Study in Engineering and Applied Science*.

The professional degree of Master of Professional Studies (Agriculture) with a concentration in agricultural engineering is intended for those who want to further their training for practitioner-type work in agricultural technology and who do not intend to become involved in engineering design and research. An applicant must have a baccalaureate degree in agricultural technology or in a related physical or biological sciences-oriented curriculum. Each M.P.S. (Agr.) degree applicant must submit scores of either the GRE or the Miller Analogies Test. A preliminary curriculum proposal must accompany an application for the M.P.S. (Agr.) degree program.

Faculty and Specializations

For information about current research projects, a prospective student should write to the graduate faculty representative.

Energy: L. D. Albright, J. R. Cooke, W. W. Gunkel, W. J. Jewell, D. C. Ludington, W. F. Millier, G. E. Rehkugler, M. B. Timmons, L. Walker
 Environmental engineering and waste management: W. H. Brutsaert, R. W. Guest, D. A. Haith, W. J. Jewell, C. A. Shoemaker, T. S. Steenhuis, M. F. Walter
 Food and biological engineering: L. D. Albright, J. A. Bartsch, J. R. Cooke, R. B. Furry, D. C. Ludington, J. Lumley, R. E. Pitt, R. H. Rand, G. E. Rehkugler, N. R. Scott, C. A. Shoemaker
 Handling and processing materials: J. A. Bartsch, R. B. Furry, R. W. Guest, W. F. Millier, G. E. Rehkugler
 International agricultural development: W. W. Gunkel, L. H. Irwin, Y. Parlange, T. S. Steenhuis, M. F. Walter
 Local roads: L. H. Irwin
 Power and machinery: J. R. Cooke, W. W. Gunkel, W. F. Millier, R. E. Pitt, G. E. Rehkugler
 Soil and water engineering: W. H. Brutsaert, D. A. Haith, Y. Parlange, T. S. Steenhuis, M. F. Walter
 Structures and their environment: L. D. Albright, J. A. Bartsch, R. B. Furry, K. Gebremedhin, R. W. Guest, D. C. Ludington, N. R. Scott, M. B. Timmons

Major and Minor Subjects (areas of concentration are in parentheses) Agronomy (atmospheric sciences, field crop science, remote sensing, seed technology, soil science)

English-speaking applicants should submit GRE results.

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 also have access to newly constructed growth chambers and greenhouse facilities on the campus and to three main field stations near Ithaca. Seed technology studies are also conducted 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) or the Boyce Thompson Institute for Plant Research on the campus. A limited number of students can do most or all of their research overseas.

Faculty and Specializations

Agricultural meteorology: K. P. Gallo
 Climatology: B. E. Dethier
 Crop chemistry: W. B. Duke, D. L. Linscott, R. L. Obendorf
 Crop ecology: G. W. Fick, T. L. Setter, R. W. Zobel
 Crop physiology: W. B. Duke, G. W. Fick, A. C. Leopold, R. L. Obendorf, T. L. Setter, P. L. Steponkus, R. W. Zobel
 Crop production: W. J. Cox, R. F. Lucey, W. D. Pardee, R. R. Seane, M. J. Wright
 Crop stress: A. C. Leopold, P. L. Steponkus
 Dynamical meteorology: D. A. Paine
 Forest soils: S. J. Riha
 General meteorology: B. E. Dethier, K. P. Gallo, W. W. Knapp, D. A. Paine
 Genetic purity of seeds: N. F. Weeden (Geneva)
 Organic soils: J. M. Duxbury
 Physical meteorology: W. W. Knapp
 Plant biochemistry: T. A. La Rue
 Plant mineral nutrition: D. L. Grunes, R. M. Welch
 Remote sensing: W. R. Philipson
 Seed microbiology: G. E. Harman (Geneva)
 Seed physiology and biochemistry: A. A. Khan (Geneva), A. C. Leopold, R. L. Obendorf, N. F. Weeden (Geneva)
 Seed testing and certification: W. D. Pardee, A. G. Taylor (Geneva)
 Soil chemistry: J. M. Duxbury, D. L. Grunes, M. B. McBride
 Soil fertility: D. R. Bouldin, D. L. Grunes, D. J. Lathwell, W. S. Reid, T. W. Scott
 Soil microbiology: M. Alexander
 Soil morphology, genesis, and cartography: R. B. Bryant, G. W. Olson, A. Van Wambeke
 Soil physics: R. D. Miller, V. A. Snyder, R. J. Wagenet
 Soil and plant studies in aquatic environments: D. R. Bouldin, D. J. Lathwell, J. H. Peverly

Agronomy

Graduate Faculty Representative R. J. Wagenet,
 1002 Bradfield Hall

Soil and water conservation: V. A. Snyder
 Tropical crops: selected faculty
 Tropical soils: A. Van Wambeke
 Weeds and herbicides: W. B. Duke, D. L. Linscott

Animal Breeding

Graduate Faculty Representative D. Van Vleck,
 B22 Morrison Hall

Major and Minor Subject (areas of concentration are in parentheses) Animal Breeding (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 essential.

GRE aptitude test scores are recommended but not required.

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. Some assistantships are available.

Faculty and Specializations

Animal cytogenetics: S. E. Bloom
 Genetics of physiological and behavioral traits in domestic livestock: E. A. B. Oltenacu
 Immunogenetics: R. R. Dietert
 Livestock breeding in the tropics: R. E. McDowell
 Quantitative genetics of poultry: D. L. Cunningham
 Statistical and quantitative genetics, with particular emphasis on selection programs for improvement of large animals: R. W. Everett, P. A. Oltenacu, E. J. Pollak, R. L. Quaas, L. D. Van Vleck

Animal Science

Graduate Faculty Representative R. L. Quaas, 114 Morrison Hall

Major and Minor Subject (areas of concentration are in parentheses) Animal Science (animal nutrition, animal science, physiology of reproduction)

Preference is given to applicants whose credentials indicate strong undergraduate preparation both in the animal sciences and in related biological and physical sciences. GRE aptitude test scores are required.

The field requires one additional member on the Special Committees of both M.S. and Ph.D. candidates (i.e., three for M.S., four for Ph.D.). At least one member of the Special Committee must not be a member of the faculty in the department in which the chairperson holds an appointment. As part of their training, students are required to assist with the teaching program of the department. The F. B. Morrison Fellowship in Livestock Feeding and a number of departmental assistantships are available on a competitive basis to students with appropriate interests.

In addition to M.S. and Ph.D. programs, a program leading to the Master of Professional Studies (Agriculture) degree is available in this field. This program is intended primarily for professionally successful applicants who want to further their academic training in animal science but whose interests may not be oriented toward research.

Depending on specific objectives, applicants may also want to examine opportunities in the Fields of Animal Breeding, Food Science and Technology, Nutrition, and Physiology.

Faculty and Specializations

R. E. Austic: animal nutrition; amino acids; nitrogen metabolism
 R. C. Baker: food science; poultry; meat; eggs; fish
 D. E. Bauman: nutritional biochemistry; intermediary metabolism
 D. H. Beermann: meat processing; muscle biochemistry
 S. E. Bloom: animal cytogenetics
 R. D. Boyd: monogastric nutrition
 W. R. Butler: animal physiology; neuroendocrinology
 L. E. Chase: ruminant nutrition
 G. F. Combs, Jr.: animal nutrition; nutritional biochemistry
 D. L. Cunningham: poultry management
 W. B. Currie: animal physiology
 T. R. Dockerty: meat processing
 J. M. Elliot: dairy cattle nutrition
 H. N. Erb: herd health management
 R. W. Everett: dairy cattle breeding
 R. H. Foote: animal physiology; artificial insemination
 D. G. Fox: beef cattle nutrition
 D. M. Galton: dairy cattle management
 R. C. Gorewit: lactation biology; reproductive physiology
 W. Hansel: animal physiology and endocrinology
 H. F. Hintz: equine nutrition
 D. E. Hogue: animal nutrition; sheep
 K. Keshavarz: poultry nutrition
 J. A. Marsh: immunology; physiology
 C. C. McCormick: mineral nutrition and adrenal function
 R. E. McDowell: livestock production in warm climates
 W. G. Merrill: dairy cattle feeding and management
 E. A. B. Oltenacu: animal breeding and genetics
 P. A. Oltenacu: animal breeding; livestock production systems
 E. J. Pollak: animal breeding and genetics
 R. L. Quaas: animal breeding and genetics
 J. B. Russell: rumen microbiology
 R. D. Smith: physiology; reproduction; lactation
 T. R. Smith: dairy management information systems; dairy farm economics
 C. J. Sniffen: dairy cattle nutrition
 J. R. Stouffer: meat science; muscle biology
 M. L. Thorney: animal nutrition; beef cattle management
 N. L. Vandemark: creativity; research management; physiology
 P. J. Van Soest: ruminant nutrition; rumen metabolism
 A. van Tienhoven: reproductive physiology; neuroendocrinology
 L. D. Van Vleck: animal breeding and genetics
 R. G. Warner: animal nutrition

Anthropology

Graduate Faculty Representative Carol Greenwood, 212 McGraw Hall

Major and Minor Subjects (areas of concentration are in parentheses) Anthropology (applied anthropology, archaeology, culture and meaning, historical anthropology, physical anthropology, psychological anthropology, social anthropology); Archaeology (M.A. major only). Since the faculty members conceive of their discipline as a unified field, an area of concentration may be designated only for the minor.

A committee consisting of three members of the faculty and a graduate student (the graduate faculty representative is chairperson) evaluates all applications for admission and financial support. All applicants must submit GRE scores unless they reside in an area where the test is not given or the requirement is waived for some other reason. Applications should also include a term paper, an honors thesis, a research report, or some other sample of written work.

The Field of Anthropology recommends that graduate students seeking a career in anthropology plan to complete the Ph.D. program. Since opportunities for persons holding only the M.A. are limited, applicants who intend to terminate their studies at the master's level are admitted only under special circumstances, which are stated in the field's brochure.

The deadline for receipt of completed applications is January 15.

Every graduate student must pass an examination in at least one literary language other than his or her native language. The student's Special Committee may set additional language requirements.

Every graduate student is expected to gain experience as a teaching assistant.

The field's brochure, available from the graduate faculty representative, contains detailed information about policies, the curriculum, and sources of financial aid.

Faculty and Specializations

Africa: V. R. Dyson-Hudson, T. P. Volman
 Anthropological history and theory: J. A. Boon, D. J. Greenwood, K. A. R. Kennedy, A. T. Kirsch, R. J. Smith
 Applied anthropology and culture change: M. L. Barnett, F. W. Young
 Archaeology: J. S. Henderson, T. F. Lynch, T. P. Volman
 Architecture, comparative: R. D. MacDougall
 Biological (physical) and biocultural anthropology: V. R. Dyson-Hudson, D. J. Greenwood, J. D. Haas, K. A. R. Kennedy
 Chinese studies: P. S. Sangren
 Cross-cultural studies: W. W. Lambert, F. W. Young
 Culture and meaning: J. A. Boon, D. H. Holmberg, B. J. Isbell, A. T. Kirsch, K. S. March, J. T. Siegel
 Demography: K. A. R. Kennedy, P. S. Sangren
 Ecological anthropology: V. R. Dyson-Hudson
 Economic anthropology: D. J. Greenwood, P. S. Sangren
 European studies: D. J. Greenwood

Expressive culture (art, literature, life histories, anthropological photography and sculpture): R. Ascher, K. S. March, R. J. Smith
 Historical anthropology: D. J. Greenwood, A. T. Kirsch, R. J. Smith
 Japanese studies: R. J. Smith
 Latin American studies: C. J. Greenwood, J. S. Henderson, B. J. Isbell, T. F. Lynch, F. W. Young
 Legal and political anthropology: C. J. Greenwood, J. T. Siegel
 Oceania: B. Lambert
 Psychological anthropology: B. J. Isbell, W. W. Lambert
 Religion, comparative: D. H. Holmberg, A. T. Kirsch, P. S. Sangren, J. T. Siegel, R. J. Smith
 Social organization: J. A. Boon, D. J. Greenwood, D. H. Holmberg, B. Lambert, K. S. March, J. T. Siegel, R. J. Smith
 South Asian studies: D. H. Holmberg, K. A. R. Kennedy, R. D. MacDougall, K. S. March
 Southeast Asian studies: M. L. Barnett, J. A. Boon, A. T. Kirsch, J. T. Siegel
 United States society and culture: R. Ascher, C. J. Greenwood
 Urban studies: B. J. Isbell, R. J. Smith
 Women's studies: D. H. Holmberg, K. S. March

Applied Mathematics

Graduate Faculty Representative P. Holmes, 275 Olin Hall

Major and Minor 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 with undergraduate backgrounds that contain a substantial mathematical component. Applicants interested in applied mathematics may also want to investigate programs offered by the Fields of Computer Science, Mathematics, Operations Research, Statistics, Theoretical and Applied Mechanics and by various other fields in the physical sciences and engineering.

All applicants should submit GRE scores, and foreign students for whom English is not the native language should submit TOEFL scores.

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
- R. G. Bland: linear programming; combinatorial optimization; networks and matrices
- J. H. Bramble: numerical analysis; partial differential equations
- H. J. Carlin: microwave and network techniques
- C. Cohen: fluid dynamics; transport phenomena; light scattering; polymer systems
- T. F. Coleman: algorithms; numerical optimization
- R. L. Constable: theory of computing; automata; logic
- D. F. Delchamps: linear and nonlinear dynamical systems; control theory; estimation and identification
- R. Durrett: probability theory
- E. Dynkin: probability theory
- G. S. Ezra: theoretical chemistry; chemical physics
- R. Farrell: mathematical statistics
- T. L. Fine: decision theory; foundations of probability; modeling
- M. E. Fisher: foundation and applications of statistical mechanics; combinatorics
- W. H. J. Fuchs: mathematical methods of physics
- L. Gross: analysis; mathematics of quantum theory
- K. E. Gubbins: statistical mechanics of liquids; computer simulation of liquids
- J. Guckenheimer: dynamical systems; differential equations
- D. C. Heath: applied probability; stochastic control; game theory
- C. Heegard: communications; information systems
- P. Holmes: nonlinear mechanics; dynamical systems; bifurcation theory
- J. H. Hubbard: fractals; iteration; ordinary differential equations
- C.-Y. Hui: fracture mechanics; high-temperature crack propagation; geomechanics; asymptotic methods
- R. A. Jarrow: mathematical economics
- J. T. Jenkins: nonlinear field theories in mechanics; continuum mechanics
- H. Kesten: probability theory
- M. Kim: biomathematics; bioengineering
- 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
- G. S. S. Ludford: fluid and magnetofluid dynamics; combustion; related mathematical methods
- F. T. Luk: parallel matrix computations
- J. L. Lumley: fluid mechanics; stochastic processes; turbulence
- M. K. Majumdar: mathematical economics
- G. L. Nemhauser: combinatorial and integer optimization; operations research
- A. Nerode: logic; recursive functions and computability; automata
- L. E. Payne: partial differential equations
- S. L. Phoenix: probability models of the failure of materials
- N. U. Prabhu: stochastic processes; analysis and control of stochastic systems
- R. H. Rand: differential equations; dynamical systems; biomechanics
- E. E. Salpeter: theoretical astrophysics; nuclear theory; statistical mechanics
- A. H. Schatz: numerical analysis; partial differential equations
- S.-F. Shen: aerodynamics; rarefied gasdynamics
- C. A. Shoemaker: applications of optimization methods to environmental and ecological problems
- F. L. Spitzer: probability theory and analysis
- P. H. Steen: hydrodynamic stability; nonlinear fluid dynamics
- R. S. Strichartz: mathematical analysis
- M. S. Taqqu: probability; statistics; econometrics; operations research; computer simulation
- H. M. Taylor: applied probability and statistics
- J. S. Thorp: optimal control with application to power systems and robotics
- M. J. Todd: mathematical programming; combinatorics
- L. E. Trotter: discrete optimization
- C. F. VanLoan: numerical analysis
- L. B. Wahlbin: numerical analysis of partial differential equations
- L. I. Weiss: statistical decision theory
- B. Widom: physical chemistry; statistical mechanics

Applied Physics

Graduate Faculty Representative R. A. Buhrman, 211 Clark Hall

Major and Minor Subject Applied Physics (only students not majoring in applied physics may take this as a minor)

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.

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. 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 GRE aptitude scores (verbal, quantitative, analytical) is required. The advanced physics test is recommended.

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 and Specializations

- D. G. Ast: amorphous materials and polymeric materials
- P. L. Auer: energy policy; plasma physics
- J. M. Ballantyne: integrated optical devices; semiconductor lasers and detectors; solar cells
- B. W. Batterman: solid-state physics; synchrotron radiation; X-ray and neutron diffraction
- J. M. Blakely: surface physics and chemistry
- R. A. Buhrman: superconducting devices; solid-state and low-temperature physics; submicron lithography
- K. B. Cady: reactor physics
- D. D. Clark: experimental nuclear and reactor physics
- T. A. Cool: molecular lasers; chemical physics
- P. C. T. de Boer: high-temperature gas dynamics; plasma physics
- F. D. Drake: radio emission from pulsars; radio and radar studies of the moon and planets
- L. F. Eastman: microwaves; solid-state plasma
- D. T. Farley: geomagnetic physics
- M. E. Fisher: mathematical physics; statistical mechanics; phase transitions and critical phenomena
- H. H. Fleischmann: plasma physics; thermonuclear fusion
- E. R. Grant: molecular and chemical physics
- K. E. Gubbins: statistical mechanics of liquids; liquid surfaces
- D. A. Hammer: plasma physics; thermonuclear fusion
- M. O. Harwit: astrophysics
- J. R. Houck: astrophysics
- P. L. Houston: molecular and chemical physics
- M. S. Isaacson: scanning transmission electron microscopy; electron nanolithography
- B. L. Isacks: seismology; global tectonics
- H. H. Johnson: mechanical behavior of solids
- M. C. Kelley: geomagnetic physics
- P. M. Kintner: geomagnetic physics
- V. O. Kostromin: low-energy nuclear and atomic physics
- E. J. Kramer: low-temperature physics; polymers
- J. A. Krumhansl: theoretical and applied physics
- A. F. Kuckes: geophysics; plasma physics
- B. R. Kusse: electron-beam physics; plasma physics
- C. A. Lee: solid-state physics; semiconductors
- A. Lewis: cellular biophysics; transduction mechanisms in visual photoreceptor cells; active transport across cell membranes
- R. L. Liboff: plasma physics; statistical mechanics
- R. V. E. Lovelace: plasma-physics theory; astrophysics
- J. W. Mayer: particle-solid and solid phase reactions
- R. P. Merrill: surface physics
- J. K. Moffat: protein crystallography; structure and function of proteins
- J. A. Nation: plasma physics; thermonuclear fusion

- M. S. Nelkin: statistical physics; turbulent fluid flow
- J. E. Oliver: seismology; global tectonics
- C. R. Pollock: lasers; molecular spectroscopy; quantum electronics
- T. N. Rhodin: physics and chemistry of surfaces; interfaces of metals and semiconductors
- A. L. Ruoff: high-pressure phenomena; imperfections in crystals; creep
- M. M. Salpeter: biophysics
- D. N. Seidman: defects in solids; radiation damage
- B. M. Siegel: electron microscopy; ion lithography
- J. Silcox: electron microscopy and spectroscopy
- R. M. Spanswick: biophysics; ion transport
- R. N. Sudan: plasma physics
- C.-L. Tang: quantum electronics
- D. L. Turcotte: aerospace engineering; gasdynamics; geophysics
- W. W. Webb: cellular biophysics; chemical physics; cooperative phenomena; hydrodynamics; physical optics; photon correlation spectroscopy
- C. B. Wharton: plasma physics; microwave electronics
- J. R. Wisenfeld: physical chemistry; chemical physics; chemical lasers; chemical application development
- E. D. Wolf: microcircuits; solid-state devices
- G. J. Wolga: magneto-optics; quantum electronics; light scattering in solids; photoacoustic spectroscopy

Architecture

Graduate Faculty Representative W. Goehner, 156 East Sibley Hall

Major and Minor Subjects (areas of concentration are in parentheses) Design (architectural design, urban design); Architectural Science (building technologies and environmental science, computer graphics)

Graduate study in the Field of Architecture may be pursued in design, leading to the Master of Architecture degree, 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 specify 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.

GRE aptitude (verbal and quantitative) test scores are required of all applicants who reside in the United States and are recommended for foreign students.

Design

Students who have satisfactorily completed an accredited undergraduate professional program for 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 who 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. On fulfilling the requirements for the Bachelor of Architecture, they may be admitted to the graduate program.

Two areas of major concentration are offered: architectural design and urban design. These areas are sufficiently broad to verge on each other 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.

The programs leading to the Master of Architecture 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, and an additional member at the student's option. The thesis is directed by the Special Committee.

Architectural Science

Students with undergraduate degrees in architecture, architectural engineering, or the various branches of engineering or computer science are likely candidates for the graduate program in architectural science. Its objectives are (1) to afford an opportunity for students of architecture to expand their creative design potential by increasing their knowledge and understanding of environmental science and building technologies; (2) to provide a framework within which students who have graduated in other technical disciplines may explore computer science, computer graphics, and computer-aided design methods. Students enrolling for studies in computer graphics use the facilities of the interdisciplinary Laboratory of Computer Graphics.

Ordinarily four terms of residence will be required to complete the program of study, depending on the student's background and experience.

Faculty and Specializations

J. W. Axley: architectural technology
 W. Goehner: architectural design; urban design
 D. P. Greenberg: architectural technology; structural analysis and design; suspension structures; computer graphics; model analysis
 B. Jones: architectural history; architectural structures; city and regional planning
 A. Kira: human engineering and psychological aspects of architecture
 M. Kubelik: architectural history
 R. MacDougall: anthropological methods applied to architecture
 A. MacKenzie: architectural design methods; urban design
 J. C. Miller: architectural design
 L. J. Mirin: landscape architectural history; urban landscape design
 V. Mulcahy: architectural design
 J. P. Ostlund: architectural design
 C. F. Otto: architectural history

K. C. Parsons: urban design; land use; institutional planning; history of collegiate architecture
 C. W. Pearman: architectural design; urban design; housing; building systems
 T. F. Peters: architectural technology
 J. Reps: city and regional planning
 H. Richardson: architectural design; urban design; housing in developing countries
 M. Romanach: architectural design
 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
 M. Schack: architectural design; urban design
 M. Schlier: architectural technology
 J. P. Shaw: architectural design; urban design
 S. W. Stein: urban design; site planning; urban renewal; housing
 O. M. Ungers: housing; urban design
 V. Warke: architectural design
 J. A. Wells: urban design; housing; building systems
 M. N. Woods: architectural history

Faculty for the M. Arch. Degree Only

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

Art

Graduate Faculty Representative Z. Blum, 100 Tjaden Hall

Major and Minor Subject (areas of concentration are in parentheses) Creative Visual Arts (painting, sculpture, graphic arts, and photography)

Applicants must have a bachelor's degree or its equivalent and must clearly demonstrate professional promise in art by submission of a slide portfolio (maximum, twenty). 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 sixty credits and is intended for those who want to further their education as artists. Candidates must complete eighteen credits for courses in the history of art, either as graduate or undergraduate students, and must earn at least twelve credits for academic work outside the Department of Art.

The buildings that house the programs are open twenty-four hours a day; they are adjacent to the Fine Arts Library (100,200 volumes) and next door to the University's Herbert F. Johnson Museum of Art.

Every M.F.A. candidate must (1) prepare a written thesis, (2) offer a thesis exhibition of studio work completed during residency, and (3) give an oral defense of the written thesis and exhibition. The written thesis may deal with the major concerns of the student's own work or with some aesthetic or historical issue in art. The oral defense of the written thesis is to be presented at the time of the thesis exhibition.

Graduate painting is under the direction of Professors Blum, Jessup, Mikus, Quin, and Singer. Students work in private studios in Tjaden Hall. Graduate sculpture is under the direction of Professors Bertoia, Cole, and Squier. The sculpture program has its own building, a 45- by 180-foot converted foundry with 14-foot ceilings and a bronze casting facility. 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 Poleskie, Page, and Meyer. The program's facilities in Olive Tjaden Hall include etching presses, lithographic presses, and proof presses. The photography program, directed by Professors Bowman and Locey, has facilities in Sibley Hall, which is located next to Olive Tjaden Hall. The program involves study of various photographic processes such as black and white, color, nonsilver, and large-format, with emphasis on both aesthetics and technique.

Faculty and Specializations

R. Bertoia: sculpture
Z. Blum: drawing
S. J. Bowman: photography
J. Cole: sculpture
E. Colker: printmaking
R. Jessup: painting and drawing
J. Locey: photography
E. Meyer: graphic arts
E. Mikus: painting and drawing
G. Page: graphic arts
B. Perlus: photography
S. Poleskie: graphic arts
L. Quin: painting and drawing
A. Singer: painting and drawing
J. Squier: sculpture

Asian Studies

Graduate Faculty Representative L. Lee, 388 Rockefeller Hall

Major Subject East Asian Studies (for M.A.)

Minor Subjects Asian Studies, East Asian Linguistics, South Asian Linguistics, Southeast Asian Linguistics

Asian studies is available as a minor field of concentration for Ph.D. candidates 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 that cuts across area boundaries. Because specialization in Asian studies 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 East Asian literature and religion, in medieval or modern Chinese history, and in Southeast Asian history.

M.A. candidates may major in East Asian studies. This program is designed for students whose career goals require only the M.A. degree, as well as for those who want to continue in a major Ph.D. field but do not have the necessary language or area background.

Proficiency in speaking and reading Chinese or Japanese is required for the M.A. Candidates who have never studied an East Asian language will be expected to complete Cornell's FALCON Program. This program offers full-time intensive language training in Chinese and Japanese. Thereafter each candidate must complete one year of full-time study (normally four courses each semester) in Asian studies. Students who at entrance already have some language training will have language programs individually designed for their particular needs and may, if they are advanced enough, complete the M.A. requirements in as little as one academic year. All students are required to write an M.A. thesis.

All applicants are required to submit GRE scores (aptitude and advanced tests).

There are at Cornell three programs concerned with teaching and research on Asia—the China-Japan Program, the South Asia Program, and the Southeast Asia Program (see pp. 20, 23). The Southeast Asia Program in languages and area studies receives funding through the Higher Education Act of the U.S. Department of Education.

Asian languages currently offered are Burmese, Cambodian, Cebuano, Chinese (Mandarin, Cantonese, and Hokkien), Hindi-Urdu, Indonesian, Japanese, Javanese, Malay, Pali, Sanskrit, Sinhalese, Tagalog, Tamil, Telegu, Thai, and Vietnamese.

Graduate students in Asian studies are eligible for the National Resource Fellowships offered by the United States Department 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 research awards for Taiwan, India, Indonesia, Japan, Malaysia, Pakistan, the Philippines, and Thailand.

For additional details, consult the Department of Asian Studies, 388 Rockefeller Hall.

Faculty and Specializations

China

M. G. Bernal: political science
S. G. Cochran: history
E. M. Gunn, Jr.: modern literature
L. C. Lee: human ecology
J. McCoy: linguistics and literature
T. L. Mei: literature and philosophy
V. Nee: sociology
C. A. Peterson: medieval history
C. Ross: linguistics

P. S. Sangren: anthropology
V. Shue: government
M. W. Young: art history

Japan

K. Brazell: literature
B. deBary: literature
B. Faure: religion
E. H. Jorden: linguistics
V. Koschmann: history
T. J. Pempel: government
R. J. Smith: anthropology
M. W. Young: art history

South Asia

E. C. Erickson: rural sociology
J. W. Gair: linguistics
D. Holmberg: anthropology
M. F. Katzenstein: government, India, ethnicity
G. B. Kelley: linguistics
K. A. R. Kennedy: anthropology
K. March: anthropology
G. M. Messing: classics and linguistics
S. J. O'Connor: art history
T. T. Poleman: agricultural economics

Southeast Asia

B. R. Anderson: government
R. Barker: agricultural economics
M. L. Barnett: development sociology
J. A. Boon: anthropology
E. W. Coward, Jr.: rural sociology
M. F. Hatch: music
C. Hirschman: sociology
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
D. K. Wyatt: history

Visiting Professors

Southeast Asia: Alexander B. Griswold, Breezewood Foundation
China-Japan: James Nickum, visiting associate professor of economics

Astronomy and Space Sciences

Graduate Faculty Representative J. Veverka, 312 Space Sciences Building

Major and Minor Subjects Astronomy (astronomy, astrophysics, 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 GREs, 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: relativity and cosmology; dynamics of the interstellar gas; solar system dynamics and magnetohydrodynamics; theory of stellar structure; stellar evolution; nuclear astrophysics; stellar systems and stellar statistics; gravitational theory; X-ray sources; black holes; chemistry of the interstellar medium

Atmospheric and ionospheric radio investigations: dynamics of the atmosphere and ionosphere; incoherent electron scattering; refraction, scattering, and attenuation due to the inhomogeneous nature of the troposphere and ionosphere; propagation of radiowaves in ionized media

Infrared astronomy: spectroscopic studies of dust clouds, ionized hydrogen regions, and shocked regions; development of novel spectrometric techniques; observations from ground-based telescopes and aircraft

Planetary studies: observational, theoretical, and laboratory studies of planetary atmospheres, surfaces, and interiors; spacecraft investigations such as Viking, Voyager, and Galileo, and earth orbital missions; investigations of asteroids, comets, and ring systems; dynamics of planetary atmospheres; exobiology and prebiological organic chemistry

Radio astronomy: distribution and classification of radio sources; radar investigations of the planets and asteroids; solar radio observations; studies of gaseous nebulae; interstellar radio lines; radio galaxies, quasars, pulsars

Space vehicle instrumentation: instrumentation relating to solar system exploration, including cameras and spectral mappers; tenuous gas and particle-flux measurements; infrared observations from rockets and satellites

Graduate students in this field may be connected with the Cornell University Center for Radiophysics and Space Research, which possesses, and is planning, important facilities for solar-system investigations both by space-vehicle and by radio methods. Center personnel use large optical telescopes in the American Southwest and Hawaii and actively cooperate with the Jet Propulsion Laboratory and NASA centers such as Goddard and Ames. Students may also be connected with the Cornell-operated National Astronomy and Ionosphere Center, Arecibo, Puerto Rico, the largest radar-radio telescope in the world. Students often conduct thesis research at Arecibo or at other major radio observatories.

Further details of the above organizations and facilities are available in brochures and can be obtained by writing to the respective organizations or to the Graduate Faculty Representative, Astronomy and Space Sciences, Cornell University, Space Sciences Building.

Faculty and Specializations

S. V. W. Beckwith: infrared astronomy; molecular spectroscopy; interstellar clouds
A. L. Bloom: geomorphology; planetary geosciences
J. A. Burns: solar system physics; celestial mechanics
D. B. Campbell: radar astronomy; planetary studies
J. M. Cordes: radio astronomy; pulsar research

F. D. Drake: radio astronomy; solar system studies; pulsars; extraterrestrial intelligence
 D. T. Farley: electrical engineering; ionospheric physics
 P. J. Gierasch: atmospheric dynamics and planetary meteorology
 T. Gold: solar system physics; high-energy astrophysics; cosmology
 T. Hagfors: ionospheric studies; radar astronomy
 M. O. Harwit: infrared astronomy; interstellar and interplanetary dust; optical-transform techniques
 M. Haynes: radio astronomy; galaxy evolution; structure of superclusters
 J. R. Houck: infrared astronomy; interstellar and interplanetary dust
 M. C. Kelley: electrical engineering; ionospheric physics
 R. V. E. Lovelace: plasma astrophysics; galactic structure
 P. D. Nicholson: planetary sciences; celestial mechanics
 C. Sagan: planetary studies; solar system and interstellar organic chemistry
 E. E. Salpeter: theoretical physics; astrophysics; radio astrophysics
 S. L. Shapiro: theoretical and relativistic astrophysics
 R. N. Sudan: electrical engineering; plasma physics
 Y. Terzian: radio astronomy; interstellar matter; radio galaxies
 S. A. Teukolsky: relativistic astrophysics
 D. Turcotte: geophysics; planetary geosciences
 J. Veverka: planetary and satellite surfaces; asteroids and comets
 I. M. Wasserman: theoretical astrophysics

Biochemistry, Molecular and Cell Biology

Graduate Faculty Representative Gerald Feigenson, 252 Clark Hall

Major and Minor Subjects Biochemistry, Molecular and Cell Biology

Prior training should include calculus, physics, and chemistry sequences through introductory physical chemistry. The GRE aptitude test and advanced test in chemistry or biology are required.

Ph.D. candidates are required to teach for three 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 a member of the field as soon as possible. Although the intermediate biochemistry sequence (including the laboratory course) normally constitutes the course work requirement for the minor, other courses may be substituted at the discretion of the student's adviser.

Faculty and Specializations

W. J. Arion: structure, function, and regulation of the hepatic glucose-6-phosphatase system; metabolite transport systems in the hepatic and renal endoplasmic reticulum

B. Baird: molecular immunology; membrane biochemistry
 R. Barker: carbohydrates; glycosyl transferases; sugar phosphates
 A. Bretscher: cytoskeleton
 J. M. Calvo: control of metabolic pathways in bacteria; bacterial genetics
 T. C. Campbell: role of nutrition in chemical carcinogen metabolism; adducts of carcinogen metabolites and macromolecules
 S. J. Edelstein: structure and function of proteins; analytical ultracentrifugation; electron microscopy and image reconstruction
 G. W. Feigenson: lipid-protein interaction; membrane structure using NMR
 J. Fessenden-Raden: biochemistry; public policy
 T. D. Fox: mitochondrial genetics
 A. J. Gibson: growth regulation and membrane function in photosynthetic procaryotes
 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: nucleic acid biochemistry; transport and energy coupling in bacteria; membrane properties of tumor cells
 G. P. Hess: protein chemistry; chemical and kinetic studies of the interrelationship of structure and function in proteins, with special reference to acetylcholine receptor-mediated ion flux
 P. C. Hinkle: mitochondrial ion transport and oxidative phosphorylation
 A. T. Jagendorf: electron transport and phosphorylation mechanisms in chloroplasts; synthesis of chloroplast proteins
 M. Kazarinoff: enzyme structure and function; protein metabolism
 E. B. Keller: messenger RNA synthesis on DNA and its utilization for protein synthesis
 A. Lewis: vision; bacteriorhodopsin; laser resonance; Raman spectroscopy
 J. T. Lis: control of gene expression in *Drosophila*
 R. E. MacDonald: microbial membrane transport; energy coupling; regulation of cell growth
 J. T. Madison: amino acid and protein synthesis in plants
 R. E. McCarty: photosynthetic phosphorylation and electron transport
 J. K. Moffat: X-ray determination of protein structure; relationship between structure and function in hemoglobin and calcium-binding proteins
 E. Racker: mechanisms of enzyme action; control mechanism, structure, and function in mitochondria and chloroplasts; mechanisms in bioenergetics
 J. W. Roberts: biochemistry of genetic control
 M. Salpeter: functional ultrastructure and cellular interactions in the nervous system; techniques in quantitative EM autoradiography
 H. Scheraga: protein structure
 J. F. Thompson: mechanisms and controls of storage-protein synthesis in legume seeds; nitrogen and sulfur metabolism of plants
 Bik-Kwoon Tye: mechanism and regulation of DNA replication
 V. Utermohlen: cell-mediated immunity and slow virus diseases; fatty acids and immunity

- V. M. Vogt: structure and assembly of tumor viruses; gene expression in slime molds
 M. Watford: metabolic regulation
 W. W. Webb: biological membranes
 D. B. Wilson: biochemical genetics; membrane transport
 M. F. Wolfner: control of gene expression during *Drosophila* development
 J. F. Wootton: enzyme chemistry; relationships between structure and function
 R. Wu: nucleotide sequence analysis of phage and viral DNA; control of enzyme and DNA synthesis in eucaryotic cells
 D. B. Zilversmit: lipid and lipoprotein transport; membrane structure; atherosclerosis

Biometry

Graduate Faculty Representative Steven Schwager, 337 Warren Hall

Major and Minor Subject Biometry

Applicants must have evidence in their bachelor's or master's transcript of strength in the biological and mathematical sciences or equivalent experience. Students are required to submit scores from the GRE aptitude test.

The program in biometry deals with the development and application of statistical and mathematical methods in biology. Research may involve purely theoretical work, computer simulation studies, innovative statistical analyses of real data, or a combination of these approaches.

In addition to the other examinations required by the Graduate School the field requires a qualifying examination taken after the second term of residence.

Faculty and Specializations

- G. Casella: estimation and testing; regression
 W. T. Federer: design and analysis; biological statistics
 C. E. McCulloch: ecological statistics; linear models
 D. S. Robson: biological statistics; sampling theory
 T. J. Santner: loglinear models; selection and ranking
 S. J. Schwager: multivariate analysis; data analysis
 S. R. Searle: linear models; variance components
 B. W. Turnbull: biomedical statistics; reliability and life testing

Botany

Graduate Faculty Representative A. T. Jagendorf, 261 Plant Science Building

Major and Minor Subject (areas of concentration are in parentheses) Botany (cytology, mycology, paleobotany, plant cell biology, plant ecology, plant molecular biology, plant morphology and anatomy, plant physiology, systematic botany)

Applicants are required to provide GRE scores. Successful applicants usually achieve a combined verbal and quantitative score of at least 1,200. Students who want to major in plant physiology are advised to obtain a background in calculus, inorganic and organic chemistry, and physics before entry. Students who want

to major in plant ecology should apply through the Field of Ecology and Evolutionary Biology.

Prospective applicants are invited to correspond with faculty in their area of interest (see the list below). Further details, including courses available in the field, can be obtained from the graduate faculty representative.

In addition to a major subject in the Field of Botany, students also take course work in two other subjects of their choice, either within or outside the field. The Field of Botany has no language requirement, but individual advisers may require proficiency in one or two languages for the Ph.D. and in one language for the master's.

Research Facilities

The field offers facilities for all research programs related to the special interests of its faculty. Modern instrumentation, ranging from ultracentrifuges and electron microscopes to a gas chromatograph/mass spectrometer for hormone identification, is routinely available, as are growth and culture chambers and greenhouse facilities. The library is well stocked in botanical volumes, and the herbaria collectively represent one of the nation's major systematics resources. Cornell owns many nearby areas that are available for student research. Most of them are undeveloped and include a variety of habitats; some, however, 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 interface 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 (e.g., animal physiology, cell biology, cytology, ecology, genetics, microbiology, plant morphology, plant pathology) 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 science). These requirements may coincide in part with those of the minor subjects or may be satisfied by courses taken before entry.

Faculty and Specializations

- D. M. Bates: biosystematics and evolution of flowering plants; ethnobotany
 B. F. Chabot: physiological ecology and population biology
 L. L. Creasy: physiology and biochemistry of plant phenolics
 P. J. Davies: investigation of plant developmental physiology using defined genotypes; physiology and hormonal regulation of plant senescence

- J. Doyle: molecular approaches to plant systematics; evolutionary studies of gene structure and function
- E. D. Earle: plant tissue and cell culture; genetic manipulation; cytology and physiology of protoplasts
- E. E. Ewing: physiology of tuberization with emphasis on hormonal control; carbohydrate transformations in plants and tubers
- V. E. Gracen: corn genetics; molecular biology and breeding; genetics of disease resistance and cytoplasmic male sterility
- G. Hrazdina: enzymology of flavonoid biosynthesis; chemistry and enzymology of secondary plant metabolites
- J. W. Ingram, Jr.: systematics of flowering plants with emphasis on anatomical approaches
- A. T. Jagendorf: photophosphorylation and chemistry of the coupling factor; chloroplast ribosomes and protein synthesis
- R. P. Korf: systematics and nomenclature of fungi, lichens, and mycetozoa
- T. LaRue: biological nitrogen fixation; metabolism and analysis of nitrogenous compounds
- A. C. Leopold: developmental physiology; seed physiology; physiology of senescence; physiology of growth regulation
- P. M. Ludford: postharvest physiology with emphasis on hormonal balances that influence storage and yield
- R. E. McCarty: plant molecular biology; bioenergetics of photosynthesis
- P. L. Marks: plant succession; woody plant demography; plant community
- M. A. Mutschler: physiological genetics in tomato and *Brassica* spp.; insect resistance and ripening mutants in tomato; cytoplasmic traits and nuclear-cytoplasmic interaction in tomato and *Brassica*
- F. Negrin: carbohydrate metabolism in higher plants
- K. J. Niklas: paleobotany; organic geochemistry; evolutionary patterns as deduced from the fossil record
- R. L. Obendorf: seed physiology; seed formation; germination; seedling growth
- D. J. Paolillo, Jr.: developmental plant morphology and anatomy
- M. V. Parthasarathy: phloem structure and function; plant ultrastructure (electron microscopy); microfilaments; cytology
- L. E. Powell, Jr.: plant hormones; shoot growth and dormancy; growth and development, especially of woody plants
- R. M. Spanswick: ion transport; electrophysiology of plant cell membranes; physiological determinants of yield
- P. L. Stepunkus: stress physiology; cold acclimation and freezing injury; drought resistance
- A. Szalay: molecular genetics of nitrogen fixation; homologous recombination in blue-green algae; chromosomal gene transfer in plant cells using promoter fusions
- J. F. Thompson: reactions and control mechanisms in amino acid biosynthesis and protein synthesis; seed storage proteins and their genes
- R. Turgeon: leaf development and movement of photosynthates; crown gall physiology
- N. W. Uhl: systematics and anatomy of the palmaria and other monocotyledons
- N. F. Weeden: genetics and biochemical evolution of flowering plants; subcellular compartmentation of enzymes
- M. D. Whalen: biosystematics and chemotaxonomy of the Solanaceae
- R. Wu: cloning and DNA sequence analysis of plant genes
- O. C. Yoder: molecular biology of filamentous fungi; molecular mechanisms of host-parasite interaction
- D. A. Young: plant systematics; angiosperm phylogeny; cladistics
- M. Zaitlin: mechanisms of replication and pathogenesis of plant viruses and viroids

Chemical Engineering

Graduate Faculty Representative C. Cohen, 318 Olin Hall

Major and Minor Subjects (areas of concentration are in parentheses) Chemical Engineering (applied mathematics and computational methods; biochemical engineering; chemical reaction engineering; classical and statistical thermodynamics; fluid dynamics, rheology, and biorheology; heat and mass transfer; kinetics and catalysis; polymers and materials science; surface science)

Although most applicants will have satisfactorily completed the equivalent of the fundamental work required by an accredited curriculum in chemical engineering, outstanding students with such undergraduate majors as chemistry, materials science, microbiology, or physics are encouraged to apply. Such students will normally require an extra semester or summer term of residence.

Chemical engineering is required of all students, either as a major or as a minor. Candidates are expected to pursue study and research that will give them a deeper comprehension of the basic and applied sciences and will develop initiative, originality, and creative ability. Theses may involve either 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

- D. S. Clark: biochemical engineering; affinity chromatography; immobilized enzymes and cells; thermophilic organisms and thermostable enzymes
- C. Cohen: polymer solutions; polymer composites; rheology; light scattering; injection molding
- R. K. Finn: fermentation of kinetics; agitation and aeration; microbial polysaccharides; chemical waste treatment
- K. E. Gubbins: classical and statistical thermodynamics of liquid mixtures; prediction of multicomponent phase equilibria; transport properties; computer simulation of liquids
- P. Harriott: kinetics and catalysis; process control; diffusion in membranes and porous solids
- R. Merrill: surface chemistry and physics; scattering of electrons, atoms, and molecules from solids; catalysis corrosion; adhesion
- W. L. Olbricht: fluid mechanics; polymer rheology; biomedical engineering
- 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; immobilized microbes; microbial growth and interaction; growth of plant cells; mathematical models of cells
 J. C. Smith: heat transfer; mixing; mechanical separations
 P. H. Steen: fluid mechanics; hydrodynamic stability; mathematical methods in chemical engineering
 W. B. Streett: high pressure experiments on fluids; computer simulation
 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

Chemistry

Graduate Faculty Representative B. K. Carpenter, 328 Baker Laboratory

Major and Minor Subject (areas of concentration are in parentheses) Chemistry (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 Ph.D. and M.S. programs should have the equivalent of an A.B. with a major in chemistry, including courses in analytical, inorganic, organic, and physical chemistry as well as mathematics and physics. Unusually promising students may be admitted with deficiencies in undergraduate training but will have to make up the deficiencies. Applicants should take the GRE aptitude (verbal and quantitative) tests and advanced test in chemistry.

The program of graduate study is designed to give broad training in the fundamentals of chemistry and in methods of research. Graduate students will ordinarily pursue those objectives by taking advanced courses, participating in organized and informal seminars, and carrying out and reporting on research projects in their major subject.

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. and Ph.D. candidates. A proficiency test in biochemistry is offered for students who plan to carry on related work. Those tests are given a few days before registration for the fall term. Results will be used to help the Special Committee plan the student's program. Remedial course work may be required of students with poor test scores.

Students majoring in organic and bioorganic chemistry must pass two cumulative examinations prior to the Admission to Candidacy Examination and six examinations prior to the thesis presentation. In addition, they must prepare and defend an original research proposal, usually after passing the Admission to Candidacy Examination.

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 *An Introduction to Graduate Study in Chemistry* is available from the graduate faculty representative. The brochure describes in some detail the varied research interests of the chemistry faculty.

Faculty and Specializations

- H. D. Abruña: analytical
 A. C. Albrecht: physical
 B. A. Baird: biophysical
 S. H. Bauer: physical
 J. M. Burlitch: inorganic, organic
 B. K. Carpenter: inorganic, organic
 J. C. Clardy: analytical, bioorganic, organic
 D. B. Collum: organic
 W. D. Cooke: analytical
 G. S. Ezra: theoretical
 R. C. Fay: inorganic
 M. E. Fisher: theoretical
 J. H. Freed: physical, theoretical
 B. Ganem: bioorganic, organic
 E. R. Grant: physical, theoretical
 K. E. Gubbins: theoretical
 G. G. Hammes: biophysical, physical
 R. Hoffmann: theoretical
 P. L. Houston: physical
 F. W. McLafferty: analytical, organic, physical
 J. E. McMurry: bioorganic, organic
 J. Meinwald: bioorganic, organic
 W. T. Miller: organic
 G. H. Morrison: analytical
 R. F. Porter: inorganic, physical
 T. Rhodin: physical
 H. A. Scheraga: biophysical, physical
 K. H. Theopold: inorganic
 D. A. Usher: bioorganic, biophysical, organic
 B. Widom: physical, theoretical
 J. R. Wiesenfeld: physical
 C. F. Wilcox, Jr.: bioorganic, organic, theoretical
 P. T. Wolczanski: inorganic

City and Regional Planning

Graduate Faculty Representative D. Lewis, 203 West Sibley Hall

Major and Minor Subject (areas of concentration are in parentheses) City and Regional Planning (city and regional planning, planning theory and systems analysis, regional science, urban and regional theory, urban planning history, environmental planning and design [minor only], international development planning [minor only], regional economics and development planning [minor only], social and health systems planning [minor only])

Students in city and regional planning learn to design, evaluate, and implement policies and programs that affect the social, economic, and physical development of urban and regional areas, including those in the Third World.

The field offers a program leading to the professional degree of Master of Regional Planning (M.R.P.) and a program leading to the Ph.D. and participates in the program leading to the Master of Professional Studies (International Development)—M.P.S. (I.D.). Special joint degree programs are available with the Law School, the Field of Architecture, and the Field of Landscape Architecture. Applicants who have lived in the United States for the past year are required, and others are strongly urged, to submit recent GRE aptitude test scores.

Requirements for the professional degree of M.R.P. differ from those required by the Graduate School for other master's degrees. In this program students may use resources from throughout the University to select an area of specialization from such concentrations as community development and land use; environmental, social, and health systems planning; historic preservation; planning information systems; planning politics; quantitative methods and modeling; and regional and international planning, as well as others listed under faculty specializations. Other specializations in education, housing, manpower, public management, and transportation can be organized in conjunction with programs in other units on the campus. The M.R.P. program normally requires four residence units, sixty credit hours, and the completion of a satisfactory thesis or project report.

The M.P.S. (I.D.) program, offered in conjunction with the Field of International Development, is a twelve- to eighteen-month program (2-2/5 residence units) for experienced professionals who have specific training needs or for mid-level professionals from other fields who want short-term training in planning. The program is described in the department's brochure *International Studies in Planning*.

Most Ph.D. candidates transfer from the Cornell Master of Regional Planning program. Applications are also welcomed from outside the University. Most applicants who do not hold M.R.P. degrees from recognized programs will first be required to enroll in the Cornell M.R.P. program and at least to complete course work equivalent to that required in the first year of the M.R.P. program. Applicants who hold the master's degree in related fields and who have had acceptable experience in planning practice will sometimes be considered for direct admission. Competence in basic analytical and research methods is required. This requirement may be fulfilled after entering the program. The field recommends that a qualifying examination be taken during the first year of study.

Research and Study Opportunities

Some recent research projects and specialized training programs in which faculty and students in the field have been engaged include a work-study training program, a local government assistance program, a study of the effects of natural disasters, a comparative analysis of development policies for lagging regions in

the United States and abroad, a history of urban development and planning, an economic/demographic/energy demand model of New York State, a study of the impact of industrial locations on regional economies, studies of technology assessment and science policy, and evaluations of state environmental policies and technical assistance for urban and regional plans in various developing countries. Research is carried out within the department as well as within such specialized units as the Center for International Studies and the Center for Environmental Research.

Introductions to the various aspects of the field are available through the summer Program in Progressive Planning, the Summer Institute on Historic Preservation Planning, the other formal summer programs, and sometimes through other summer courses. Details are available in the *Announcement of the Summer Session*.

The department awards a limited number of teaching and research assistantships and encourages participation in internship programs in Washington, D.C., Albany, New York, and other urban centers, that allow students to spend a semester or a year on a job and in part-time study.

Additional information may be obtained from the graduate faculty representative.

Faculty and Specializations

- R. S. Booth: land-use and environmental law; critical area preservation; historic preservation law
- P. Clavel: administration; regional development
- S. Clemhout: environmental planning; public policy
- S. Czamanski: economic analysis; growth models; location theory; regional accounts
- A. T. Dotson: comparative planning; administrative theory; developing countries
- J. Forester: social and political theory; social policy; planning organization; critical theory
- W. W. Goldsmith: regional development and administration; political economy; international development
- W. Isard: location theory; conflict management procedures; general social science theory and methods; environmental management
- B. G. Jones: quantitative analysis; urbanization theory; environmental health; historic preservation
- D. B. Lewis: planning in developing countries; technology transfer
- D. W. Nelkin: science and technology; environmental policy
- P. Olpadwala: political economy; international rural development; technology development and transfer; transnational corporations
- K. C. Parsons: urban land use; large-scale development; university planning
- J. W. Reps: land-use regulation; planning administration; comparative planning; history of American city planning
- S. Saltzman: quantitative methods and modeling; systems analysis; information processing; regional analysis
- S. W. Stein: land use; design; housing; historic preservation

- I. R. Stewart: urban housing; urban and suburban development; American urban history
 M. A. Tomlan: building conservation technology; documentation methods for preservation; history of the preservation movement

Civil and Environmental Engineering

Graduate Faculty Representative Gordon Fisher, 309 Hollister Hall

Major and Minor Subject (areas of concentration are in parentheses) Civil and Environmental Engineering (environmental engineering, environmental systems engineering, geotechnical engineering, hydraulics and hydrology, remote sensing, structural engineering, transportation engineering, water resource systems, structural mechanics [minor only])

GRE test results, although not required, are useful in the objective evaluation of credentials and in financial aid decisions.

For either an M.S. or Ph.D. program, an area of concentration may be selected from the above list.

Each student in the Ph.D. program must 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. 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.

Additional information may be obtained 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 practices of the field. Specific exit requirements are set for the Master of Engineering (Civil) degree that include a broad-based technical background in the field, courses in design, and professional practice. Students concentrate in one of the areas within civil and environmental engineering. Additional information may be obtained by writing to the graduate professional engineering programs representative, Hollister Hall. Brochures that more fully describe the separate areas are available on request.

Research Opportunities

Study and research are usually carried on in one of the major subject areas listed below.

Environmental Engineering Environmental (sanitary) 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.

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, population management, and other urban and regional planning problems.

Geotechnical Engineering This area is concerned with the study of the engineering properties and use of earth materials and the measurement of the behavior of earth and rock structures. 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, coastal oceanography, and meteorology as related to the wet earth and the atmosphere.

Remote Sensing Qualitative and quantitative analyses of aircraft and satellite images, as well as other remotely sensed data, are used in inventorying, monitoring, and assessing earth resources and the environment.

Structural Engineering In addition to the conventional aspects of structural analysis and design, interests in this department include such relatively new topics as computer-aided analysis methods, design of nuclear reactor containment structures, small-scale models, shells, earthquake engineering, optimization, behavior of thin-steel structures, structural safety analysis using probability theory, and structural materials. Emphasis is placed on the common fundamental background, theoretical and experimental, of all structural engineering.

Transportation Engineering Study and research in transportation engineering embrace policy, planning, design, and evaluation of transport systems and the relationships between transport supply and demand, land use, and regional development. The approach is multimodal and systems oriented; emphasis is placed on the use of quantitative and analytical techniques of operations research and economics. Urban transport of people and goods is stressed in both course work and research.

Water Resource Systems This area involves the development and application of mathematical and computer-modeling techniques for defining and evaluating alternative design and 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 using water resources.

Faculty and Specializations

- J. F. Abel: structures
 J. J. Bisogni: environmental engineering
 W. H. Brutsaert: hydrology
 R. I. Dick: environmental engineering
 G. P. Fisher: environmental systems
 P. Gergely: structures
 J. M. Gossett: environmental engineering
 D. P. Greenberg: structures

M. D. Grigoriu: structures
 D. A. Haith: water resource systems
 K. C. Hover: structures; engineering materials
 A. R. Ingrassia: structures
 G. H. Jirka: environmental hydraulics
 F. H. Kulhawy: geotechnical engineering
 J. A. Liggett: hydraulics
 L. W. Lion: environmental engineering
 P. L.-F. Liu: hydraulics
 D. P. Loucks: water resource and environmental systems
 W. R. Lynn: environmental systems
 W. McGuire: structures
 A. H. Meyburg: urban transportation planning and engineering
 A. H. Nilson: structures
 N. Orloff: technology assessment
 T. D. O'Rourke: geotechnical engineering
 T. Peköz: structural engineering; experimental research
 W. R. Philipson: remote sensing
 W. D. Philpot: remote sensing
 R. E. Schuler: economics
 C. A. Shoemaker: environmental systems; ecosystem analysis
 F. O. Slate: engineering materials
 J. R. Stedinger: stochastic hydrology; environmental systems
 M. A. Turnquist: transportation systems analysis
 R. N. White: structures

Classics

Graduate Faculty Representative Judith R. Ginsburg, 129 Goldwin Smith Hall

Major and Minor Subject (areas of concentration are in parentheses) Classics (ancient philosophy, classical archaeology, Greek language and literature, Latin language and literature, medieval and Renaissance Latin literature, ancient history [minor only], classical mythology [minor only], classical rhetoric in the original or translation [minor only], Indo-European linguistics [minor only])

Applications must include GRE scores.

Candidates for the M.A. ordinarily spend two semesters attending seminars and studying under 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.

In addition to seminars and other course work, the Ph.D. candidate is responsible for developing 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.

The requirements for students majoring in classical archaeology differ from those outlined above in that readings and examinations in archaeology are substituted for some of those in Latin and Greek. Details are available upon request. There are also opportunities to participate in excavations during the

summer; Cornell is currently sponsoring an excavation, under the direction of J. E. Coleman, at the Bronze Age site of Alambra in Cyprus.

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 on Plato and on the pre-Socratics (one in the Department of Classics, one in the Department of Philosophy), two courses on Aristotle and 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, which provide a stipend of \$5,000 plus tuition.

Cornell Studies in Classical Philology

Since 1887, forty-one volumes have appeared in the series Cornell Studies in Classical Philology. 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: epic and tragedy; mythology
 A. H. Bernstein: ancient history
 K. Clinton: Greek epigraphy; Greek religion; Greek literature
 J. E. Coleman: Greek archaeology and art
 M. L. Cook: Greek historians; Greek science and medicine
 G. J. Fine: ancient philosophy
 J. R. Ginsburg: Roman history and historiography
 T. H. Irwin: ancient philosophy
 J. Jasanoff: Indo-European linguistics
 J. J. John: paleography and medieval history
 N. Kretzmann: ancient philosophy
 N. Krevans: Greek and Roman lyric poetry; Hellenistic culture
 P. I. Kuniholm: classical archaeology; Aegean dendrochronology
 G. M. Messing: Indo-European linguistics
 P. T. Mitsis: ancient philosophy
 A. Nussbaum: Greek and Indo-European linguistics
 D. I. Owen: Assyriology; ancient near Eastern history and archaeology
 P. Pucci: textual criticism; Greek epic, drama, mythology
 A. Ramage: Greek and Roman art and architecture
 B. Strauss: Greek history
 W. Wetherbee: medieval Latin; medieval philosophy and literature

Communication Arts

Graduate Faculty Representative Ronald E. Ostman, 307 Roberts Hall

Major and Minor Subject 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. 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, (3) application of these elements to specific communication problems, and (4) evaluation of communication effectiveness. Focus of the program is on communication planning—the strategic application of communication knowledge and technology (both mass media and interpersonal) to information or education campaigns in or for organizations—rather than on technical competence in media operation.

Applicants from the United States and Canada must submit recent GRE scores. Applicants from other countries should submit recent TOEFL scores. Applications are encouraged from persons with experience in communication. Evidence of superior performance in the professional field will be considered in combination with academic records and GRE scores.

All applicants are expected to have some competence in one area 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 has research interests in communication and rural development, diffusion of news and information, intercultural communication, interpersonal communication, mass communication, new communications technology, organizational communication, public relations—public information, public opinion, telecommunications, and video communication.

Faculty

N. E. Awa, R. L. Bruce, R. D. Colle, M. A. deTurck, W. W. Frank, C. J. Glynn, D. G. McDonald, J. B. Maas, R. E. Ostman, C. W. Scherer, D. F. Schwartz, W. B. Ward, S. A. White, J. P. Yarbrough

Comparative Literature

Graduate Faculty Representative E. Santí, 267 Goldwin Smith Hall

Major and Minor Subject Comparative Literature

The Field of Comparative Literature at Cornell offers a Ph.D. in major areas from the Renaissance to the modern period, with particular emphasis on nineteenth- and twentieth-century European literature and literary criticism and theory. (There is no supervision of students whose background and interest are in Asian languages and literatures.)

Because the field is small (about fifteen students) it is possible to plan individual programs of study that ensure thorough preparation in literary traditions and detailed awareness of literary and theoretical problems. In addition to primary texts covering the full range of the European literary tradition, the field devotes much attention to theoretical studies (for example, hermeneutics, Marxist theories, the aesthetics of the Frankfurt School, structuralism and semiotics, rhetorical studies, stylistics, and the problems of reader response).

Entering students design a program in consultation with an advisory committee of three faculty members. Areas of concentration and principal advisers should be selected no later than the end of the first year of residence. Students should have command of at least two foreign languages so as to be able to attend graduate seminars in the literatures immediately upon entrance. Courses in genre, theory and criticism, and literary history, both within the Field of Comparative Literature and in the fields of separate national literatures, prepare the student for the general examinations, which are usually taken in the third year of study. The examinations, both written and oral, typically require that a student, by focusing on three national literatures, demonstrate knowledge of (1) a major genre or an aspect of theory, with broad historical coverage; (2) a single historical period or a literary movement; and (3) a major literary figure. After passing the examinations, the student begins work on a dissertation. The department has no terminal M.A. program (and consequently does not admit students seeking this degree only), but an M.A. is granted after the successful completion of all course work and the aforementioned examinations. Each candidate is required to do at least one year of classroom teaching as part of the doctoral program.

The field requires applicants to submit scores of the Graduate Record Examinations Aptitude and Advanced Tests.

Faculty and Specializations

C. M. Arroyo: Spanish and comparative literature
J. A. Boon: anthropology and comparative literature
A. F. Caputi: English and comparative literature
C. M. Carmichael: biblical studies
W. Cohen: comparative literature
J. Culler: English and comparative literature
E. G. Fogel: English
H. Gates: English
G. Gibian: Russian and comparative literature
S. Gilman: German
A. Grossvogel: French and Italian
D. I. Grossvogel: French and comparative literature
P. U. Hohendahl: German and comparative literature
W. W. Holdheim: French and comparative literature
R. E. Kaske: English
W. J. Kennedy: comparative literature
J. Monroe: comparative literature
E. Rosenberg: English and comparative literature
E. Santí: Spanish and comparative literature
K. Vernon: Spanish
L. Waugh: linguistics and comparative literature

Computer Science

Graduate Faculty Representative C. Van Loan, 223 Carpenter Hall

Major and Minor Subject (areas of concentration are in parentheses) Computer Science (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.

Applications must include general GRE scores and the score of one advanced test in any area.

A candidate for the 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).

A booklet describing graduate work in computer science may be obtained by writing to the graduate faculty representative.

Computer Facilities

The principal computing facility at Cornell consists of an IBM 370/168, two IBM 4341s, and a DEC 2060, located in Langmuir Laboratory near the campus, and directly linked to satellite computers at three campus locations. The College of Engineering and the Department of Computer Science are served through a satellite station in Upson Hall and by individual terminals. For its own research the department has three VAX 11/780s, two PDP 11/60s, and numerous workstations (Sun, Xerox, Symbolics, and others). The University also has a laboratory for research in graphics.

Faculty and Specializations

Database systems and information retrieval: D. Bitton-Friedland, G. Salton
Graphics: D. Greenberg
Numerical analysis: J. H. Bramble, T. F. Coleman, F. Luk, C. Van Loan
Programming languages and systems: O. Babaoglu, K. Birman, R. W. Conway, A. Demers, D. Gries, G. Johnson, A. Moitra, A. Nicolau, F. B. Schneider, R. Teitelbaum, S. Toueg
Robotics: J. Hopcroft
Theory of computation and algorithms: R. L. Constable, J. Gilbert, J. Hartmanis, A. Nerode, V. Vazirani
VLSI systems: G. Bilardi, K. Karplus

Consumer Economics and Housing

Graduate Faculty Representative Jennifer Gerner, 137 Martha Van Rensselaer Hall

Major and Minor Subjects (areas of concentration are in parentheses) Consumer Economics (consumer and household economics, family resource management); Housing

All candidates resident in the United States during the year preceding matriculation at Cornell must submit scores of the GRE aptitude test with their applications.

Consumer Economics and Housing is a multidisciplinary field that applies economics, sociology, and home economics to the study of family and consumer behavior and their welfare. Although the overall focus is on the economics of family and consumer behavior, consumer economics and housing also utilizes the theories and practical concerns of sociology and family management. The two major subjects, Housing and Consumer Economics, emphasize a blend of theory and application. The program's goal is to equip students with a broad social science perspective and with the techniques for applying this perspective to a wide range of problems and issues facing families.

Consumer Economics focuses on the household and consumer. It is concerned with household decision-making behavior (e.g., household demand, household production, market work decision making), with consumer information and regulation, with the effects of consumer-related policies on the behavior of households, with the quality of family life, and with the functioning of consumer markets. The area of concentration Family Resource Management seeks to improve family life by examining how families organize their collective resources as a means of meeting their needs and goals. This area studies decision-making processes within the family, how families utilize resources, and how changes in these processes affect (or can affect) the quality of family living.

Housing broadly looks at the residential environment from economic and sociological perspectives. This area examines the behavior of individuals and institutions within the housing market and explores the impact of local and federal policies on housing markets, housing availability, and spatial distribution. Emphasis is placed on the neighborhoods, demographic aspects of housing demand, the housing finance system, land-use regulation, consumer and producer market behavior, and residential attitudes.

Faculty and Specializations

W. K. Bryant: economics of the household; consumer policy; welfare policy
P. S. K. Chi: demography; residential mobility; housing; health; consumer policy
S. Clemhout: housing policy; urban systems; consumer decision making; human ecology
A. J. Davey: family decision making; family resource management; assessment of effective management
J. L. Gerner: household production; consumer policy; labor supply; human capital
A. J. Hahn: community decision making
R. K. Z. Heck: family resource management; household consumption and savings; consumer credit; household insolvency; financial counseling
J. M. Hogarth: family resource management; consumer policy
E. S. Maynes: consumer economics and policy; consumer behavior; economics of informational imperfections

52 Development Sociology

P. B. Pollak: political economy of housing; dynamics of neighborhood change; housing policy
J. R. Robinson: family resource management and marketing
N. C. Saltford: consumer economics and marketing
S. White-Means: health policy; regulatory policy
P. M. Zorn: housing economics; local government financing; zoning and residential choice

Design and Environmental Analysis

Graduate Faculty Representative Franklin Becker, E-425 Martha Van Rensselaer Hall

Major and Minor Subjects (areas of concentration are in parentheses) Design (interior); Human-Environment Relations (facility planning and management, human factors, human-environment relations)

The field offers graduate study leading to the M.A., M.S., or Master of Professional Studies (Human Ecology) degree. Within the Field of Design and Environmental Analysis one may study in two major areas: *Design*, concentrating on the creation of interior spaces and associated products, and understanding these in their historical context, and *Human-Environment Relations*, which focuses on the interaction of people with their physical surroundings and on the planning and management of complex work, residential, and health facilities.

Students in these majors are expected to develop strength in design and/or the social sciences and planning (focus of the major), and to coordinate that strength with knowledge from other disciplines (focus of the minor) to solve problems pertinent to their area. The multidisciplinary nature of the field permits students with diverse backgrounds to study in the above areas.

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 must submit GRE (verbal and quantitative) test scores. A portfolio of visual materials or slides is required of design majors. It should be sent to the graduate faculty representative. About two-thirds of the graduate students in the field hold teaching or research assistantships. General fellowships are also available to students in the field.

Research and Study Opportunities

The field has well-equipped studios and workrooms, an art and environmental design gallery, a learning resource center, darkrooms and photographic facilities, instruments for behavioral analysis, and a wood workshop. Computer terminals linked to the University computer, as well as personal computers, are available in the research areas.

Faculty and Specializations

F. D. Becker: facility planning and management; office planning and design; postoccupancy evaluation; design programming; environmental psychology
A. Bushnell: interior design/space planning; interior product design

S. Danko: interior design; lighting and furniture acoustics research; graphic design
P. Eshelman: interior design/space planning; interior product design; computer workstation design and analysis
L. Mankowski: interior design/space planning; low-technology housing systems; passive solar energy
G. C. Millican: interior design; design history
E. R. Ostrander: programming and postconstruction evaluation; interdisciplinary collaboration; gerontological applications of environmental research
W. R. Sims: facility planning and management; environment perception/cognition; design methods; environmental programming; postoccupancy evaluation
G. Sloan: human-environment relations; human factors; ergonomics; lighting; acoustics

Development Sociology

Graduate Faculty Representative Frank Young, 34 Warren Hall

Major and Minor Subject (areas of concentration are in parentheses) Development Sociology (agricultural and natural resource sociology, community and regional sociology, methods of social research [minor only])

The field offers training leading to the M.S. and Ph.D.; emphasis is placed on rural or agricultural societies, community and regional organization, and development processes in these contexts. 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 countries, and for college teaching.

GRE scores are requested of United States and Canadian applicants and are essential for fellowship applicants. Completion of the master's 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 on 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 at Cornell) or, otherwise, 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.

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 part of an assistantship, in connection with research supervised by the faculty.

Research and Study Opportunities

Some field members draw upon the resources of the New York State Agricultural Experiment Station at Geneva for their research. Recent activities under this sponsorship include studies of small-town growth and decline, service delivery in rural areas, decision making in farm families, employment trends in the northeastern United States, the social organization of agriculture, multicounty and regional development, the perception and management of environmental problems, and the social impact of biotechnology. Research abroad includes studies of small irrigation systems, small-farmer agriculture, processes of regional development, and social movements. Students and/or faculty are actively conducting research in Southeast Asia, Latin America, and Africa. Many of these studies deal with the relationship of agricultural production to social organization and the conditions of growth for communities and regions.

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.

Although most doctoral theses are based on field-collected data, the department and the University have rich resources for the study of New York State rural areas, past and present, as well as a great number of data tapes for the study of less-developed countries.

Requirements for Areas of Concentration

Agricultural and Natural Resource Sociology For the Ph.D., a student is expected to demonstrate (1) a thorough knowledge of social theory with special emphasis on theories of social organization and social change; (2) knowledge of past and current research on the analysis of systems of agriculture and natural resources; (3) knowledge of research methods with special emphasis on research design, data collection, and analytical techniques relevant to the study of agricultural and natural resource systems. For the M.S., a student is expected to demonstrate a general knowledge of (1) and of (2) or (3).

Community and Regional Sociology For the Ph.D., a student is expected to demonstrate (1) a thorough knowledge of social theory with special emphasis on theories of social change and socioeconomic development; (2) knowledge of past and current research on change and development in communities and regions; (3) knowledge of research methods with special emphasis on research design, data collection, and analytical techniques relevant to the study of change. For the M.S., a student is expected to demonstrate a general knowledge of (1) and of (2) or (3).

Faculty

S. B. Bacharach, M. L. Barnett, F. H. Buttel, H. R. Capener, P. Clavel, E. W. Coward, Jr., P. R. Eberts,

B. Edmonston, E. C. Erickson, J. D. Francis, P. Garrett, C. C. Geisler, C. Hirschman, M. Lancelle, J. C. Preston, L. K. Williams, R. M. Williams, Jr., F. W. Young, J. J. Zuiches

East Asian Literature

Graduate Faculty Representative Tsu-Lin Mei, 388 Rockefeller Hall

Major and Minor Subject (areas of concentration are in parentheses) East Asian Literature (classical Chinese literature, classical Chinese thought, classical Japanese literature, Japanese religion, modern Chinese literature, modern Japanese literature, Asian religions [minor only], Chinese linguistics [minor only], Japanese linguistics [minor only])

At least two years of Chinese or Japanese language study are required for admission, and prior work in English or European literature is desirable. Candidates for the Ph.D. whose undergraduate education has been in a Chinese or Japanese university are normally expected to have taken a degree in English or European literature before admission. All applicants are required to submit GRE scores for the aptitude and advanced tests.

Students may concentrate exclusively in either Japanese or Chinese, or they may do work in both areas. Minor subjects may also be chosen from other fields in the University, such as other literatures, comparative literature, linguistics, and theatre arts. Individual programs are designed in consultation with the Special Committee chairperson.

Candidates for the M.A. are expected to take five semester courses and write a thesis. A reading knowledge of Japanese is essential for the M.A. in Chinese, and candidates in Japanese must study either Chinese or *Kambun*.

A Ph.D. qualifying examination is given during the second semester of the first year. For the Ph.D., a reading knowledge of a second East Asian language is normally required, and reading knowledge of at least one European language is highly desirable. Candidates for the Ph.D. are eligible for fellowships offered under the China-Japan Program.

Faculty and Specializations

K. Brazell: Japanese literature
B. deBary: Japanese literature
B. Faure: Asian religions
E. M. Gunn, Jr.: Chinese literature
E. Jordan: Japanese linguistics
J. McCoy: Chinese and Japanese linguistics; Chinese literature
T.-L. Mei: Chinese literature and philosophy

Ecology and Evolutionary Biology

Graduate Faculty Representative Peter L. Marks, E. 427B Corson Hall

Major and Minor Subjects (areas of concentration are in parentheses) Ecology (animal ecology, applied ecology, community and ecosystem ecology,

limnology, oceanography, physiological ecology, plant ecology, population ecology, theoretical ecology, vertebrate zoology); Evolutionary Biology (ecological genetics, population biology, systematics)

Applicants are required to present GRE aptitude test and advanced biology test scores.

The language requirement for the Ph.D. is proficiency in one language. One language is required for the master's. 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 are 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
- B. Bedford: wetland plant ecology
- W. L. Brown: systematics of ants; evolutionary theory
- T. J. Cade: environmental biology of vertebrates
- B. F. Chabot: plant ecophysiology
- J. L. Cisse: arthropod biology and paleobiology; marine ecology and paleoecology
- 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
- T. Gavin: ecology and behavior
- G. G. Gyrisco: ecology of forage crop insects; economic entomology
- H. C. Howland: mathematical biology; systems analysis
- K. A. R. Kennedy: physical anthropology
- J. P. Kramer: ecology and biology of entomopathogenic microbes; especially protozoans
- S. Levin: population biology; mathematical biology; applied mathematics
- G. E. Likens: limnology; aquatic ecology; analysis of ecosystems
- A. McCune: ichthyology; evolutionary biology and systematics
- R. J. MacIntyre: molecular evolution
- 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
- K. J. Niklas: plant evolution and morphology

- R. T. Oglesby: ecosystems, with particular emphasis on enrichment and population problems
- B. Peckarsky: invertebrates
- D. Pimentel: population ecology; ecosystems
- F. H. Pough: environmental physiology, especially of lower vertebrates; herpetology
- W. Provine: history of biology, especially evolutionary theory
- D. Rabinowitz: population and community ecology of plants
- M. E. Richmond: vertebrate ecology and reproduction
- R. B. Root: comparative ecology and the organization of terrestrial communities
- P. Sherman: ontogeny of animal social behavior
- C. A. Shoemaker: applications of mathematics and operations research to problems in ecosystems management
- M. J. Tauber: reproductive behavior; photoperiodism and biological control
- D. A. Webster: population dynamics of fishes
- M. Whalen: variation, evolution, distribution, and classification of flowering plants
- W. D. Youngs: fishery biology

Economics

Graduate Faculty Representative Tapan Mitra, 450 Uris Hall

Major and Minor Subject (areas of concentration are in parentheses) Economics (econometrics and economic statistics, economic development and planning, economic history, economic theory, economics of participation and labor-managed systems, history of economic thought, industrial organization and control, international economics, labor economics, monetary and macro economics, peace science, public finance, basic analytical economics [minor only])

In addition to their major and two minors, doctoral candidates are expected to be familiar with the methods of quantitative analysis and the fundamentals of economic theory.

The field does grant a Master's degree, but generally only students who ultimately expect to complete a Ph.D. are admitted.

Students should consult the descriptions of the Fields of Agricultural Economics, Management, City and Regional Planning, and Industrial and Labor Relations for other related subjects. Attention is also directed to the various international studies programs discussed on pp. 20-24.

The GRE aptitude test is strongly recommended for all applicants.

Since some mathematics is used in graduate courses and current economics literature, every applicant should have at least two courses in calculus. Linear algebra is also recommended. Exceptional candidates who lack such preparation may be admitted, but they will find their first year of graduate study seriously disrupted by the need to remedy this deficiency.

A more detailed brochure is available upon request.

Faculty and Specializations

Econometrics and economic statistics: K. Burdett, R. S. Chirinko, D. Easley, R. Ehrenberg, R. H. Frank, W. H. Greene, R. Joyeux, N. Kiefer, M. Majumdar, T. Mitra, R. E. Schuler, E. Thorbecke
 Economic development and planning: T. E. Davis, G. Fields, G. J. Staller, J. Svejnar, E. Thorbecke, J. Vanek, H. Y. Wan, Jr.
 Economic history: T. E. Davis, P. D. McClelland
 Economics of participation and labor-managed systems: T. E. Davis, G. J. Staller, J. Svejnar, J. Vanek
 Economic theory: K. Burdett, D. Easley, L. Ebrill, R. H. Frank, E. Grinols, N. Kiefer, M. Majumdar, R. Masson, T. Mitra, U. Possen, R. E. Schuler, S. C. Tsiang, J. Vanek, H. Y. Wan, Jr., M. Yano
 Industrial organization and control: W. H. Greene, G. Hay, A. E. Kahn, R. Masson, R. E. Schuler
 International economics: T. E. Davis, L. Ebrill, E. Grinols, G. J. Staller, E. Thorbecke, S. C. Tsiang, J. Vanek, H. Y. Wan, Jr., M. Yano
 Labor economics: R. Ehrenberg, G. Fields, N. Kiefer, J. Svejnar
 Monetary and macro economics: R. S. Chirinko, T. E. Davis, E. Grinols, U. Possen, S. C. Tsiang
 Peace science: W. Isard, M. Majumdar, R. Schuler, E. Thorbecke, H. Y. Wan, Jr.
 Public finance: R. S. Chirinko, L. Ebrill, R. E. Schuler

Education

Graduate Faculty Representative R. Bruce, 109 Stone Hall

Major and Minor Subjects (areas of concentration are in parentheses) Education (agricultural and occupational education; curriculum and instruction; educational administration; educational psychology and measurement; educational research methodology; extension, continuing, and adult education; home economics education; philosophy and sociology of education; science, mathematics, and environmental education); Educational Psychology and Measurement

The Field of Education is conceived broadly and reflects a dual concern for theoretic and professional knowledge. Areas of practical study include public and private schools, colleges, universities, state and federal agencies, and industrial enterprises.

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 and Master of Professional Studies (Agriculture).

All applicants whose native language is English are required to submit either a score from the GRE aptitude test (required for fellowship applications) or the score of the Miller Analogies Test.

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

Facilities

In addition to the University computer facilities, the department has a small computer installation that students use for manuscript typing and editing, for analysis of small data sets, and for instructional purposes. Also available are portable videotaping equipment, a photography laboratory, and the Instructional Materials Service.

Faculty and Specializations

Agricultural and Occupational Education

A. L. Berkey, coordinator; J. P. Bail, H. R. Cushman, W. E. Drake, J. Dunn, H. D. Sutphin, R. W. Tenney

This program serves students seeking permanent certification as teachers of agriculture in secondary schools and prepares teacher educators in agriculture, administrators in occupational education, and faculty members in two-year agricultural colleges.

Curriculum and Instruction

G. J. Posner, coordinator; W. L. Brittain, R. Bruce, W. E. Drake, D. B. Gowin, S. Hamilton, D. Henderson, C. A. McLennan, J. D. Novak, R. E. Ripple, V. N. Rockcastle, H. L. Wardeberg

This program focuses on curriculum development and its implementation in schools and colleges. Students may examine the curricula of subject areas such as science, mathematics, or art or general curriculum topics from disciplinary perspectives such as philosophy, psychology, and sociology.

Educational Psychology and Measurement

D. Hedlund, coordinator; J. Dunn, J. Greene, J. Harding, J. Maas, J. Millman, J. D. Novak, R. E. Ripple, K. Strike

This area focuses on the psychology of instruction, human learning, educational measurement, psychological assessment, life-span development, social psychology of the classroom and school, interpersonal and group processes, and specialized topics such as creativity, learning-to-learn strategies, and instructional computing in both formal and informal educational settings.

Educational Research Methodology

J. Millman, coordinator; R. L. Bruce, R. B. Darlington, D. Deshler, D. B. Gowin, J. Greene, E. Haller, C. McClintock, J. D. Novak, G. J. Posner, K. A. Strike

This program focuses on basic concepts in measurement, program evolution, statistics, and philosophy of science that underlie the design, analysis, and interpretation of investigations about educational phenomena. Current research interests include criterion-referenced testing, state and local assessment systems, evaluation models, critical appraisal of research and evaluation studies, theory of value and evaluation, attitude measurement, application of learning theory to measurement problems, and testing by computer.

Extension, Continuing, and Adult Education

D. Deshler, coordinator; N. Awa, J. P. Bail, G. Broadwell, H. B. Brown, R. L. Bruce, R. Colle, J. L. Compton, H. Cushman, D. Hedlund, R. E. Ripple, D. Sutphin

The focus is on adult education as a vital component of economic and social change, and the processes of adult learning and development. The program prepares research scholars and leaders for adult and continuing education programs in colleges and universities, development agencies, and other educational systems in the United States and abroad. Teaching and research interests include program design, management, evaluation, adult learning and development, community education, research use, and the indigenous culture as an educational medium.

Philosophy, Sociology, and Economics of Education; Educational Administration

D. H. Monk, coordinator; J. P. Bail, R. L. Bruce, J. R. Egner, D. B. Gowin, E. J. Haller, K. A. Strike

Philosophy of education applies concepts and techniques of philosophy to educational problems. Epistemology, philosophy of science, value theory, and political philosophy are linked to teaching, curriculum, learning, evaluation, research, and governance.

Sociology of education studies the internal processes of educational organizations and the links to economic and political systems.

Economics of education examines the role education plays in the formation and growth of national economics. Attention is also given to the internal efficiency of educational systems.

Educational administration (viewed from alternative perspectives provided by social science, philosophy, and administrative practice) prepares students to assume leadership positions.

Home Economics Education

M. E. Minot, coordinator; H. Burris, C. A. McLennan, L. A. Noble, B. L. Yerka

This program deals with the analysis of education as an instrument for effective change and studies the nature of change—describing, predicting, effecting, and measuring it. Students interested in becoming teacher educators complete a sequence of courses and field experiences and a practicum in field experience supervision.

Science, Mathematics, and Environmental Education

J. D. Novak, coordinator; R. A. Baer, Jr., J. Confrey, R. B. Fischer (emeritus), H. A. Geiselmann, D. B. Gowin, D. Henderson, J. Millman, G. J. Posner, V. N. Rockcastle, K. A. Strike

This program focuses on teaching, curriculum development, and research in science, mathematics, and environmental education. Special interests include conceptual change in science, philosophies of science, learning, environmental studies, and use of computers in the classroom. Certification for science teaching is available to outstanding candidates.

The following persons are also members of the Field of Education and may serve on a student's committee:

R. Babcock, S. Bacharach, D. J. Barr, R. Colle, R. Doherty, B. Mueller, D. Ritchie, C. Shapiro, L. Street, W. Trochim, J. Ziegler

Electrical Engineering

Graduate Faculty Representative P. R. McIsaac, 230 Phillips Hall

Major and Minor Subject (areas of concentration are in parentheses) Electrical Engineering (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 GREs and to have the scores sent to the 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.

Before beginning the second semester of study as a candidate for the Ph.D., each student must take a qualifying examination administered by the student's Special Committee.

In addition to University fellowships, the following are available: the John McMullen Graduate Fellowship, the Schlumberger Foundation Fellowship, the Rockwell International Corporation Fellowships, the IBM Minority Fellowship, and the RCA Electronics Research Fellowship.

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. (Electrical) is a thirty-credit curricular degree requiring an engineering design project rather than a research thesis. It is intended primarily for persons who plan to practice engineering directly, in industry or professionally. But it may also serve as the first step en route to the doctorate for those who are inclined toward the technological and design aspects of advanced engineering. For further information, contact the graduate faculty representative.

Research Opportunities

Electrical Engineering This area includes electrical measurements, instrumentation, and the conversion, transmission, and control of electrical energy. Some typical research projects include a computer-managed system to control the response of an electric power network to faults, and various digital data processing and analysis systems. Other work is closely related to research in the systems or electrophysics areas.

Electrical Systems Research in systems is concentrated in the areas of control theory, information and decision theory, and network analysis and design. Topics studied include stochastic control; optimization and approximation techniques; 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 time-varying, nonlinear, active, and/or distributed parameter networks; digital and switching circuits; computer architecture; computer vision; and parallel processing.

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, lasers and fiber optics, solid-state physics, microwave and optical phenomena in semiconductors, semiconductor devices, including microfabrication and very large scale integration techniques are among the topics studied.

Faculty

J. M. Ballantyne, T. Berger, R. Bolgiano, R. R. Capranica, H. J. Carlin, G. C. Daiman, D. F. Delchamps, L. F. Eastman, D. T. Farley, T. L. Fine, J. Frey, T. Gold, T. Hagfors, D. A. Hammer, C. D. Heegard, C. R. Johnson, Jr., K. Karplus, M. Kelley, M. Kim, P. Kintner, J. P. Krusius, W. H. Ku, C. A. Lee, R. L. Liboff, S. Linke, F. Luk, N. MacDonald, P. R. McIsaac, J. W. Mayer, J. A. Nation, B. Nichols, C. R. Pollock, C. Pottle, A. Reeves, J. L. Rosson, C. E. Seyler, V. Solo, R. N. Sudan, C.-L. Tang, R. J. Thomas, J. S. Thorp, H. C. Torg, N. M. Vrana, C. B. Wharton, E. D. Wolf, G. J. Wolga, S. Wong

English Language and Literature

Graduate Faculty Representative Laura Brown, 259 Goldwin Smith Hall

Major and Minor Subject (areas of concentration are in parentheses) English Language and Literature (American literature to 1865, American literature after 1865, American studies, creative writing, * criticism and theory [minor only], dramatic literature, English poetry, the English Renaissance to 1660, the nineteenth century, old and middle English, prose fiction, the Restoration and the eighteenth century, the twentieth century)

*Cannot be the major for the Ph.D. degree.

Admission

Applicants may request admission to either the Master of Fine Arts (M.F.A.) program in creative writing or the doctoral program or both. The Field of English rarely accepts applicants for the terminal Master of Arts degree. Except in unusual circumstances, all applicants are required to submit GRE scores (aptitude and advanced tests) and should plan to take the examinations by October. 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. The application and all supporting documents and

materials must reach the Graduate School by January 15. Because of postal delays and the last-minute rush of transcripts and letters, it will help to guarantee full consideration if applications can be filed earlier. (Since there are such a large number of applications, the field cannot assume the responsibility of notifying an applicant whose file is incomplete.)

Approximately sixteen Ph.D. candidates and eight M.F.A. candidates are enrolled each year; two or three of these may be candidates for both degrees. As the ratio of accepted students to applicants is approximately one to fifteen, competition is extremely intense and no candidate, regardless of how strong his or her credentials may be, should presume acceptance. The graduate faculty representative will be happy to meet with visiting applicants; such interviews, however, have no bearing on admission.

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. A number of M.F.A. candidates will also receive support. A student who has done graduate work elsewhere, or who has had professional teaching experience, may apply for a teaching assistantship for the first year in the program. An applicant who wants a teaching assistantship should check the appropriate blank on the admission and fellowship application.

The Programs

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

A candidate for the Ph.D. is normally expected to complete six or seven one-semester courses for credit in the first year of residence, and a total of six or seven more in the second and third years. The program of any doctoral candidate's formal and informal study, whatever his or her particular interests, should be comprehensive enough to give some familiarity with (1) the authors and works that 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. The Ph.D. student chooses a major and one or two minors. The major is selected from a list of historical, generic subjects such as the English Renaissance to 1660, the nineteenth century, or prose fiction. Minors may be selected from the same list, but students are also permitted to choose 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 a second minor from some non-American subject in the area of concentration.

Within both programs, the special committee procedure eliminates uniform course requirements and departmental examinations, provides a close working relationship between professors and students, and encourages freedom and flexibility in the pursuit of the graduate degree. The Special Committee directs and judges progress at a series of meetings with the student in which it reviews the course work, the individual work done with members of the committee and with others, and the student's own assessments of his or her progress. Before a doctoral candidate enters the fourth semester of graduate study, the Special Committee must decide whether he or she is qualified to proceed toward the Ph.D.

Doctoral candidates are expected to acquire some supervised teaching experience as part of their 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.

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 in any of several ways—for example, by presenting the undergraduate record, by taking additional courses in foreign languages and literature, or by translating and discussing documents related to the student's work in English and American literature.

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

Staff and Resources

Graduate work at Cornell offers the opportunity for professional study in a distinguished academic community of extensive resources. The Cornell University Library system includes over four million volumes; of special interest to graduate students is Olin Library, which is among the foremost university libraries in the United States. Its special holdings include Dante and Petrarch collections unique in this country, a splendid and comprehensive Wordsworth collection, the Wyndham Lewis papers, a distinguished Icelandic collection, and one of the great Joyce collections of the world. In recent years its materials have been used for major studies of romantic thought, Joyce, John Stuart Mill, Ford Madox Ford, and other important subjects.

The quality of the work done by graduate students in English is of course largely conditioned by the staff with whom they work and the academic environment which

the staff and the students together create. In addition to the distinguished Graduate Faculty in such related departments as Comparative Literature, Romance Studies, German, History, Philosophy, Theatre Arts, and Classics, the following members of the English faculty are normally available to direct graduate work and to serve on Special Committees:

American literature: * J. P. Bishop, M. J. Colacurcio, D. Fried, H. Gates, D. E. McCall, S. Mohanty, M. Seltzer, S. C. Strout
Creative writing: A. R. Ammons, W. L. Herrin, P. Janowitz, A. Lurie, K. A. McClane, J. R. McConkey, R. Morgan, S. Vaughn
Dramatic literature: A. Caputi, H. S. McMillin, T. Murray
The nineteenth century: M. H. Abrams (emeritus), C. Chase, J. Culler, M. Jacobus, D. M. Mermin, R. Parker, S. M. Parrish, P. Sawyer
Old and Middle English: R. T. Farrell, T. D. Hill, R. E. Kaske, W. Wetherbee
Prose fiction: J. F. Blackall, E. Rosenberg, D. R. Schwarz, H. Shaw, W. J. Slatoff
The Renaissance: B. B. Adams, E. G. Fogel, C. V. Kaske, C. S. Levy, D. Novarr, M. A. Radzinowicz, G. Teskey
The Restoration and the eighteenth century: F. Bogel, L. Brown, D. D. Eddy
The twentieth century: L. Green, M. Hite, P. L. Marcus, S. Siegel, J. Stallworthy

This list is illustrative rather than exhaustive, since most faculty members are available to direct work in areas other than those cited.

The creative writing staff publishes *Epoch*, a periodical of contemporary literature.

*An information sheet on American studies is available from the graduate faculty representative on request.

Entomology

Graduate Faculty Representative E. Cupp, 5138 Academic II

Major and Minor Subject (areas of concentration are in parentheses)

Entomology (acarology, apiculture, aquatic entomology, biological control, economic entomology, general entomology, insect behavior, insect biochemistry, insect ecology, insect morphology, insect pathology, insect physiology, insect taxonomy, insect toxicology and insecticide chemistry, integrated pest management, medical entomology)

Excellent facilities for laboratory and field studies are available that include the outstanding Comstock Entomological Library and a renowned insect collection.

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.

Applicants are required to submit GRE aptitude and advanced biology test scores.

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

Faculty and Specializations

- W. L. Brown, Jr.: systematics and evolution; ants
 E. W. Cupp: medical entomology; bionomics of blood-feeding Diptera
 G. C. Eickwort: insect morphology; systematics and behavior of wild bees; acarology
 H. H. Hagedorn: insect physiology, reproductive physiology; genetic control of insect vectors
 W. T. Johnson: economic entomology; insects on ornamental plants
 J. P. Kramer: insect pathology; protozoan and fungal diseases
 J. K. Liebherr: biosystematics of coleoptera; speciation
 R. A. Morse: apiculture; honeybee social behavior
 A. A. Muka: economic entomology; vegetable-crop insects; extension
 B. L. Peckarsky: aquatic entomology; behavior and community ecology of stream insects
 D. Pimentel: insect ecology; population ecology; genetic feedback
 E. M. Raffensperger: economic entomology; household insects
 D. A. Rutz: veterinary entomology; poultry and livestock pest management
 A. J. Sawyer: population dynamics; pest management; systems ecology
 M. Semel: economic entomology; vegetable-crop insects
 M. J. Tauber (department chairperson): biological control; insect behavior
 W. M. Tingey: plant resistance to insects; economic entomology
 Q. D. Wheeler: systematics and evolution of Coleoptera
 C. F. Wilkinson: insect toxicology; synergists and detoxification mechanisms

Faculty at the New York State Agricultural Experiment Station, Geneva

- T. J. Dennehy: agricultural entomology; biology, ecology, and management of grape pests
 C. J. Eckenrode: economic entomology; soil and vegetable-crop insects
 W. H. Reissig: economic entomology; insect biology and pest management
 H. Riedl: insect pest management on fruit crops; extension
 W. L. Roelofs: organic chemistry; pheromones: isolation; identification; and synthesis
 G. A. Schaefer: economic entomology; ecology of small fruit insects
 A. M. Shelton: insect pest management of vegetable crops
 D. M. Soderlund: insect toxicology; insect biochemistry

Members of the field in other departments at Ithaca

- T. Eisner: insect behavior; insect-plant interactions
 P. P. Feeny: chemical ecology; herbivorous insects
 R. B. Root: insect ecology; organization of terrestrial communities
 C. A. Shoemaker: systems analysis in pest management

Environmental Quality

Graduate Faculty Representative J. C. Thompson, Jr., C214 Schurman 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. The objective is to understand human interaction with the environment. A student takes the combination of courses, seminars, and projects considered best for him or her.

A student seeking a master's degree will ordinarily take a minimum of three courses for this minor; the courses must be in at least two areas outside the major field. A student seeking a doctoral degree will ordinarily take a minimum of five courses, in at least two areas outside the major field.

Faculty

- J. G. Babish, B. E. Dethier, R. I. Dick, L. B. Dworsky, J. M. Gossett, D. A. Haith, J. S. Jacobson, W. J. Jewell, L. W. Lion, R. C. Loehr, D. P. Loucks, W. R. Lynn, R. T. Oglesby, G. W. Olson, D. Pimentel, J. C. Thompson, R. R. Zall

Environmental Toxicology

Graduate Faculty Representative June Fessenden-Raden, 630 Clark Hall

Major and Minor Subject (areas of concentration are in parentheses) Environmental Toxicology (biochemical toxicology, ecotoxicology, genetic toxicology, nutritional toxicology, veterinary toxicology)

The field provides an opportunity for students to broaden their knowledge of the interactions of toxic elements and chemicals (drugs, pesticides, industrial pollutants, and natural products) with organisms and the environment. Specific program areas of field faculty members range from basic studies in environmental toxicology related to biochemistry, nutrition, genetics, and veterinary medicine to societal aspects such as consumer information and environmental law. Detailed information is available from the graduate faculty representative.

Entering students are expected to have had good basic undergraduate training in biology, chemistry, and mathematics. Previous experience or course work in toxicology is desirable but not essential. GRE test scores are required.

Faculty and Specializations

- M. Alexander: ecotoxicology
 J. G. Babish: risk assessment
 C. Bisogni: consumer information about toxicology
 S. E. Bloom: genetic toxicology
 C. Campbell: chemical carcinogenesis
 W. L. Castleman: pulmonary toxicology
 G. Combs, Jr.: interactions of vitamins and minerals
 R. R. Dietert: immunogenetics

J. M. Fessenden-Raden: environmental toxicology
 J. Gillett: ecotoxicology
 S. P. Gloss: aquatic toxicology
 J. Henion: analytical drug testing
 J. H. Hotchkiss: food toxicology
 S. Jasanoff: toxic substances regulation
 L. Krook: toxicologic pathology
 A. Lemley: environmental chemistry
 R. M. Lewis: environmental pathology
 D. J. Lisk: toxic residues
 G. Maylin: drug testing
 N. I. Mondy: food toxicology
 M. Morrison: nutrition and toxicology
 R. S. Parker: xenobiotic metabolism
 D. Roe: drug-nutrient interactions
 W. S. Schwark: neurotoxicology
 R. Schwartz: minerals
 G. W. G. Sharp: pharmacology
 D. M. Soderlund: insecticide metabolism
 G. S. Stoewsand: food contaminants
 R. J. Wagenet: toxicants in field soils
 D. L. Wassom: immunopharmacogenetics
 L. H. Weinstein: air pollutants
 C. F. Wilkinson: drug metabolism

Epidemiology

Graduate Faculty Representative R. H. Cypess,
 209 Diagnostic Laboratory

Minor Subject (area of concentration in parentheses) Epidemiology (human and animal epidemiology)

The Field of Epidemiology offers a graduate program as a minor field in conjunction with several major areas of specialization, including Biometry, Environmental Toxicology, Nutrition, Sociology, Statistics, Animal Science, and Veterinary Medicine. Students may pursue an M.S., M.A., or Ph.D. degree with a minor in epidemiology. All applicants should have a sound background in mathematics and in the sciences that are consistent with the requirements of their proposed field of major interest. Graduate students enrolled in the program will conduct their research in the departments of their major advisers.

Faculty for the Field of Epidemiology are from several colleges. The list below provides a description of the varied research interests of the faculty.

Faculty and Specializations

J. Babish (Preventive Medicine): risk assessment methodology; animal modeling for risk assessment in humans; significance of *in utero* exposure to toxic substances; ambient exposure to toxic materials; factors affecting the metabolism of foreign compounds
 G. Casella (Biometrics Unit): statistical decision theory; point and interval estimation; regression analysis; empirical Bayes methods
 L. C. Clark (Preventive Medicine, jointly appointed in the Division of Nutritional Sciences): nutrition and cancer epidemiology; nutritional surveillance; environmental epidemiology
 R. H. Cypess (Preventive Medicine): parasitology and the immune response; allergy and infectious diseases

B. Edmonston (International Population Program): demographic aspects of health and nutrition; urban population distribution; application of demographic theory
 H. N. Erb (Preventive Medicine): veterinary epidemiology; reproductive disorders; dairy herd fertility, production, and health
 W. T. Federer (Biometrics Unit): experimental design and analysis
 J.-P. Habicht (Division of Nutritional Sciences): nutritional surveillance; international nutrition
 D. Lisk (Toxic Chemicals Laboratory): toxicants in agricultural and environmental systems
 C. E. McCulloch (Biometrics Unit): linear statistical models
 D. S. Robson (Biometrics Unit): biological sampling and estimation; statistical models for bioassays
 T. J. Santner (Operations Research): biomedical statistics; selection theory; reliability theory
 J. M. Scarlett-Kranz (Preventive Medicine): veterinary epidemiology; zoonoses
 S. J. Schwager (Biometrics Unit): multivariate analysis; experimental design; clustering; outlier detection
 B. W. Turnbull (Operations Research): statistical methods of health studies; survival analysis; statistical methods for reliability and life testing

Floriculture and Ornamental Horticulture

Graduate Faculty Representative R. W. Langhans,
 20 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. Applicants should have strong backgrounds in biological, horticultural, and agricultural sciences and strong interests in floriculture and ornamental horticulture. Applicants are required to submit GRE test scores. For the Ph.D., 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. All students receive experience in resident teaching and cooperative extension programs.

For the Master of Professional Studies (Agriculture) degree, the field requires completion of thirty credits of courses 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 science, horticultural physiology, taxonomy of ornamental plants, landscape horticulture, and urban horticulture. Studies relating to physiology, growth and development, propagation, physiology, postharvest physiology, nutrition, weed science, horticultural

marketing, production management, and culture of floriculture and nursery crops and turfgrass may be undertaken as research for an advanced degree and should be approached from the standpoint of the basic sciences. It is appropriate to select minor areas of study from such areas as plant physiology, plant pathology, biochemistry, botany, entomology, plant anatomy, plant morphology, taxonomy, plant ecology, genetics, education, agricultural economics, agricultural engineering, and landscape architecture.

Outstanding facilities include laboratories specifically equipped for studies on growth regulators, foliar and soil analysis, tissue culture, postharvest physiology, rhizosphere analysis, and various other physiological and anatomical topics. Controlled-environment rooms, greenhouses, an outdoor nursery, and turfgrass production areas are also available.

Faculty and Specializations

- N. L. Bassuk: physiology of horticultural crops, especially in the urban environment
 R. T. Fox: retail florist shop management; merchandising, layout, and shop efficiency
 G. L. Good: nursery crop production management; nutrition
 C. F. Gortzig: floriculture crop production management; floriculture extension programming
 N. W. Hummel: turfgrass science and nutrition; soil fertility
 R. W. Langhans: culture of greenhouse crops; controlled environments
 R. G. Mower: taxonomy of ornamental plants; plant evaluation
 K. W. Mudge: physiology of nursery crops; mycorrhizae; propagation/micropropagation
 J. C. Neal: horticultural weed science
 F. B. Negrn: physiology of horticultural crops; carbohydrate metabolism; postharvest physiology
 A. M. Petrovic: turfgrass science; soil fertility; root physiology
 T. C. Weiler: florist cut, pot, and bedding crop culture; cropping systems

Landscape architecture, while a program in the Department of Floriculture and Ornamental Horticulture, operates as a separate Graduate Field. See page 72.

Food Science and Technology

Graduate Faculty Representative W. Jordan, 106 Stocking Hall

Major and Minor Subject (areas of concentration are in parentheses) Food Science and Technology (dairy science, food chemistry, food engineering, food microbiology, food processing waste and water technology, food science [general], international food science)

Candidates for the M.S. are required to register for one major within the field and one minor outside the field. Candidates for the Ph.D. are required to register for one major within the field and two minors outside the field. There are no course hour requirements for the M.S. or Ph.D. 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 GRE aptitude test scores. Foreign students are required to take the Test of English as a Foreign Language (TOEFL) in addition to the GRE.

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

Faculty and Specializations

Dairy Science

D. M. Barbano, W. K. Jordan, J. E. Kinsella, F. V. Kosikowski, R. A. Ledford, N. N. Potter, J. W. Sherbon, W. F. Shipe, R. R. Zall

Food Chemistry

T. E. Acree,* G. D. Armbruster, D. M. Barbano, J. B. Bourke,* M. C. Bourne,* J. W. Brady, J. R. Hicks, L. F. Hood,* J. H. Hotchkiss, G. Hrazdina,* J. E. Kinsella, C. Y. Lee,* B. A. Lewis, L. M. Massey,* L. R. Mattick,* D. D. Miller, N. I. Mondy, M. A. Morrison, J. M. Regenstein, R. S. Shallenberger,* J. W. Sherbon, W. F. Shipe, G. S. Stoewsand,* J. P. Van Buren,* R. H. Walter*

Food Engineering

W. K. Jordan, M. McLellan,* M. A. Rao,* G. E. Rehugler, S. S. Rizvi, J. W. Sherbon, M. L. Shuler, R. R. Zall

Food Microbiology

D. M. Barbano, C. Batt, T. H. Cottrell,* D. C. Graham, R. B. Gravani, Y. D. Hang,* F. V. Kosikowski, R. A. Ledford, N. N. Potter, J. M. Regenstein, D. F. Splittstoesser,* J. R. Stamer,* K. H. Steinkraus*

Food Processing Waste and Water Technology

Y. D. Hang,* W. K. Jordan, M. McLellan,* R. R. Zall

Food Science (General)

G. D. Armbruster, J. Babish, R. C. Baker, D. M. Barbano, D. H. Beermann, C. A. Bisogni, M. C. Bourne,* M. M. Devine, T. R. Dockerty, D. L. Downing,* D. C. Graham, R. B. Gravani, Y. D. Hang,* L. F. Hood,* W. K. Jordan, J. E. Kinsella, F. V. Kosikowski, R. A. Ledford, C. Y. Lee,* B. A. Lewis, D. J. Lisk, F. Liu, L. R. Mattick,* D. D. Miller, N. I. Mondy, R. S. Parker, N. N. Potter, J. M. Regenstein, J. W. Sherbon, W. F. Shipe, K. H. Steinkraus,* J. R. Stouffer, R. H. Walter,* R. R. Zall

International Food Science

M. C. Bourne,* D. C. Graham, Y. D. Hang,* L. F. Hood,* W. K. Jordan, J. E. Kinsella, F. V. Kosikowski, C. Y. Lee,* N. I. Mondy, W. F. Shipe, K. H. Steinkraus,* R. H. Walter*

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

Genetics

(See also the listing under Medical Sciences.)

Graduate Faculty Representative A. Blackler, G51 Emerson Hall

Major and Minor Subject Genetics

Applicants are urged to submit scores of the GRE 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 Special Committee is formed, 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 genetics 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, R. Dietert, G. M. Dunny, T. D. Fox, M. L. Goldberg, M. R. Hanson, K. Kemphues, J. Lis, R. J. MacIntyre, M. A. Mutschler, J. Roberts, A. M. Srb, B. Tye, V. Vogt, M. Wolfner, O. Yoder, S. A. Zahler

Geological Sciences

Graduate Faculty Representative Daniel E. Karig, 2124 Snee Hall

Major and Minor Subject (areas of concentration are in parentheses) Geological Sciences (economic geology, engineering geology, geobiology, geochemistry and isotope geology, geomorphology, geophysics, geotectonics, general geology, marine geology [minor only], mineralogy, paleontology, petroleum geology, petrology, planetary geology, Precambrian geology, Quaternary geology, rock mechanics, sedimentology, seismology, stratigraphy, structural geology)

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. Applicants are required to submit scores from the GRE aptitude test.

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 that will best suit their interests and talents. At least one minor subject outside the field is required for the doctoral degree.

Proficiency must be established in French, German, or Russian 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 candidate's fitness for undertaking advanced studies and will enable the Special Committee to plan programs that will make the student familiar with the requisite knowledge in the chosen areas. It must be taken before the end of the second semester in residence.

There are a number of graduate teaching assistantships available in the field. Teaching assistants who are doctoral candidates are eligible for special summer awards.

There are several departmental fellowships that have various restrictions.

The department has several special endowments that may be used to assist graduate students in their research and fieldwork, and research assistantships are available.

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 seafloor spreading and plate tectonics on a global scale; observation of current seismic activity in the South Pacific; investigation of igneous rocks in arc systems; tectonics, seismology, sedimentation and geomorphology of the central Andes; study of rocks and minerals 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; 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 located near the campus, and its facilities are available to the specialized investigator.

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 already exist 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 and systematics, biogeochemistry, limnology, soil genesis, soil mineralogy, soil and rock mechanics, aerial photo analysis, fluid dynamics, elasticity, regional planning, hydraulics and hydrology, and materials science and engineering.

Faculty

R. W. Allmendinger, W. A. Bassett, J. M. Bird, A. L. Bloom, L. D. Brown, J. L. Cisne, A. Gibbs, B. L. Isacks, T. E. Jordan, D. E. Karig, R. W. Kay, D. L. Kohlstedt, A. F. Kuckes, F. H. Kulhawy, G. H. Morrison, J. E. Oliver, T. D. O'Rourke, F. H. T. Rhodes, A. L. Ruina, A. L. Ruoff, C. Sagan, W. B. Travers, D. L. Turcotte, J. Veverka

Germanic Studies

Graduate Faculty Representative H. Deinert, 188 Goldwin Smith Hall

Major and Minor Subject (areas of concentration are in parentheses) Germanic Studies (German linguistics, Germanic literature, Old Norse [minor only], German intellectual history)

Applicants are expected to have a good background in German literature and to be fluent in the German language. The field asks all United States applicants to submit GRE scores. Since proficiency in French is required for the Ph.D., students are encouraged to begin their study of this language as early as possible.

The program in German literature at Cornell is uniquely flexible. In general, requirements are defined in terms of competence, not in terms of credit hours or specific courses. All students are expected to acquire a general knowledge of German literature and to become familiar with the tools and methods necessary for research and analysis. In addition, students are expected to acquire a more detailed knowledge of one of the following periods: medieval German literature; Renaissance, Reformation, Baroque; Enlightenment, *Sturm und Drang*, Schiller, Goethe; romanticism, *Biedermeier*, *Restauration* through *Vormärz*; realism, naturalism; twentieth-century literature.

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 history of the German language, comparative Germanic linguistics, the older Germanic languages, and the contrastive analysis of German and English. Opportunities for studying Old Norse are exceptional; the University's collection of Old Norse materials (the Fiske Icelandic Collection) is probably the most important of its kind in the world.

Drawing upon the German-oriented faculty in other departments such as Philosophy, History, Government, Psychology, and Music, students can design a program leading to a concentration in German Intellectual History.

German Area Studies combines relevant courses in history, international relations, and comparative economics with courses in German literature, culture, and language.

The qualifying examination is required of all students at the beginning of their second semester. A comprehensive examination will be administered at the end of the sixth semester of residence, after which work on the dissertation will begin. Details are contained in the *Guide for Graduate Students*, which may be requested by writing to the graduate faculty representative.

Faculty and Specializations

C. M. Arroyo: comparative literature
E. A. Blackall (emeritus): eighteenth- and nineteenth-century literature; comparative literature
S. Buck-Morss: government
H. Deinert: seventeenth-, nineteenth-, and twentieth-century literature
I. Ezergailis: nineteenth- and twentieth-century literature; women's studies
S. L. Gilman: literature from the Reformation to the present; Jewish studies; history of psychiatry
A. Groos: medieval and eighteenth-century literature
W. Harbert: Germanic linguistics; syntactic theory
P. Hohendahl: seventeenth-, eighteenth-, nineteenth-, and twentieth-century literature; literary theory; comparative literature
W. W. Holdheim: comparative literature
I. Hull: history
J. H. Jasanoff: Indo-European linguistics; historical Germanic linguistics
P. Katzenstein: government
H. L. Kufner: German dialectology; contrastive and applied linguistics
C. A. Martin: nineteenth- and twentieth-century literature; women's studies
L. M. Olschner: lyric poetry; twentieth-century literature
F. van Coetsem: Germanic linguistics; historical linguistics
A. Wood: philosophy

Government

Graduate Faculty Representative Milton J. Esman, 132 McGraw Hall

Major and Minor Subject (areas of concentration are in parentheses) Government (American politics, comparative politics, international relations, political thought, political methodology [minor only], public policy [minor only])

The field asks applicants to submit scores of the GRE aptitude test.

Students are asked (1) to acquire a thorough knowledge of the discipline, including substantial theoretical, conceptual, and substantive competence

in a major subject and a solid foundation in one minor subject; (2) to provide a clear demonstration of the methodological, linguistic, and other skills needed to conduct original scholarly research; and (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 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 members to discuss the first year's program. At the end of the first year, the student should form a Special Committee that guides and supervises the student's subsequent academic preparation and dissertation research.

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 three parts: (1) a written examination in the student's major and minor subjects; (2) an extended research paper within the student's specialized field of interest; and (3) an oral examination conducted by the Special Committee. The written examinations are normally taken before the end of the student's second year; the oral examination, at the beginning of the third. At the oral examination the student presents a thesis proposal outlining the hypotheses, data, methods, and resources needed to carry out his or her dissertation research.

The graduate Field of Government also accepts a limited number of candidates for the M.A. degree who are interested in careers in politics or public service. Preference is given to applicants who want to combine the study of political science with a specialized minor in which Cornell has distinctive strengths, such as Southeast Asian studies, peace studies, rural development, or an Asian language. The M.A. degree in government requires two full years of full-time study plus successful completion of a master's thesis.

Interdisciplinary Programs

Students are encouraged to take advantage of the numerous interdisciplinary programs, which include the Program on Science, Technology, and Society; the Cornell Institute for Social and Economic Research, the Rural Development Committee; the Peace Studies Program of the Center for International Studies; and the foreign area programs for Latin America, South Asia, Southeast Asia, China, Japan, and the Soviet Union.

Faculty and Specializations

B. R. Anderson: comparative government; nationalism; militarism; Southeast Asian studies
M. Bernal: comparative government; Chinese politics; modern Chinese history
S. Buck-Morss: political and social theory
W. J. Dannhauser: political thought
A. T. Dotson: American government; public policy
M. J. Esman: comparative government; comparative ethnic politics; politics, public administration, and rural development in third world countries

B. Ginsberg: American government and politics; elections; public opinion
M. Goldfield: American politics; labor and American politics; Marxist theory; philosophy of social science; political methodology
G. McT. Kahin: international relations; comparative politics, Southeast Asian studies
M. F. Katzenstein: comparative government; South Asia; women's studies; feminist movements; public policy
P. J. Katzenstein: comparative government; Europe; international relations; international and comparative political economy; comparative public policy; state theory
E. W. Kelley: American government; political methodology; comparative public policy
E. G. Kenworthy: comparative government; Latin America; United States policy toward Latin America
R. F. King: American government and politics; welfare policy; economic policy
I. Kramnick: political thought
R. N. Lebow: international relations
T. J. Lowi: American government and politics; public policy and administration
T. J. Pempel: comparative politics; Japan; public policy; modern industrial societies; political economy
J. G. Pontusson: comparative politics; Western Europe; political economy; comparative labor movements
J. A. Rabkin: American government; constitutional law; administrative procedure; bureaucratic politics
R. Rosecrance: international relations
M. Rush: international politics; comparative politics; Soviet domestic and foreign policy; esoteric communications; politics of succession
L. Scheinman: international relations; international law and regime development; international energy and technology; nuclear nonproliferation
M. Shifter: American politics; urban politics; national political institutions
V. B. Shue: comparative politics; China; peasant politics; socialism; revolution
S. G. Tarrow: comparative politics; Western Europe; social movements and political parties; comparative communism
N. T. Uphoff: comparative politics; third world development; local institutions and participation; South Asia; political economy; public policy

History

Graduate Faculty Representative James John, 435 McGraw Hall

Major and Minor Subjects (areas of concentration are in parentheses) History (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, modern Japanese history, Russian history, Southeast Asian history)

Applications for admission must include the scores of the GRE aptitude test. Applications are normally accepted for the fall term, but spring admission is possible.

Each major subject area 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.

Candidates for the Ph.D. in history are required to do classroom teaching as a part of their doctoral program. Most graduate students will serve for at least one year as teaching assistants in undergraduate courses. For some, however, especially those with financial support from foundations or special agencies, some voluntary teaching under the supervision of a member of their graduate committee will be an acceptable alternative.

Faculty and Specializations

- D. A. Bauch: modern English history, 1688–1914—political, social, economic, and administrative; maritime history of Western Europe, 1600–1800
- S. M. Blumin: American history—social, cultural, economic, and demographic; American urban history
- S. G. Cochran: modern Chinese history, 1644 to present—political, social, economic, and intellectual
- 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
- R. Hsia: Reformation and Counter-Reformation
- I. V. Hull: modern German history; history of women in Germany
- 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
- J. V. Koschmann: modern Japanese history
- D. LaCapra: modern European intellectual history
- W. F. LaFeber: American history; United States 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, socioeconomic, 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. Pinitner: 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. B. 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. Strauss: ancient history, Greek and Roman; classical and Hellenistic Greece; the Greek city; late antiquity and early Byzantine
- B. Tierney: medieval church history; law; political theory
- D. Usner: Native American history
- J. Weiss: modern European history, social and political; social history of technology
- L. P. Williams: history of science; nineteenth-century physical sciences
- D. K. Wyatt: modern Southeast Asian history; history of Thailand and Laos

History and Philosophy of Science and Technology

Graduate Faculty Representative: Tom Peters, 425 Caldwell Hall

Major and Minor Subject: History and Philosophy of Science and Technology

The history and philosophy of science and technology constitutes a complex interdisciplinary field that requires rigorous training in at least one of the branches of science or engineering and a thorough grounding in the humanistic traditions. Applicants to the field should have strong backgrounds in the basic sciences or in a branch of engineering, but have prior schooling also in history or philosophy, and preferably in both those areas. The faculty of the field is reluctant to overburden a student with required course work, and finds it neither realistic nor desirable to attempt to provide detailed training in all aspects of the field. The breadth and depth of training obtained will depend on the student's particular degree program and on his or her level of commitment to the field—as a major or minor.

In accordance with the general guidelines for graduate education at Cornell, the Field of History and Philosophy of Science and Technology will have no specific course work requirements, except that each student working toward the Ph.D. in the field will be expected to show proficiency equivalent to (1) four graduate-level courses in the branch of science or engineering of prime importance to subsequent thesis work, (2) four courses in history, and (3) four courses in philosophy.

History and philosophy courses in various specialties are frequently offered by other departments in addition to those of History and Philosophy. Courses in the individual branches of science and engineering are listed in the Cornell University Announcement *Courses of Study* under the individual specialties.

Students minoring in the history and philosophy of science will be expected to take a series of three courses in this area of studies.

The Graduate School requires two examinations. The Examination for Admission to Ph.D. Candidacy in the history and philosophy of science and technology is an oral examination on the student's integrative understanding, thesis prospectus, and relevant literature, taken usually in the fifth semester of residence. The final examination for Ph.D. candidates is an oral examination on the student's dissertation.

All students are required to serve one year as teaching assistants.

A student's Special Committee may recommend or require study of languages needed for research and

teaching in one of the student's areas of specialization or may suggest or require course work in a field other than the history or philosophy of science and technology.

Collaborative Work with the Medical College in New York City

A year in residence for historical research at the Cornell Medical College can be arranged, particularly in the area of psychiatry, where the prospective candidate would work with members of the faculty of the Section on the History of the Behavioral Sciences within the Department of Psychiatry.

Weekly Colloquium

Graduate students working toward the Ph.D. in the history and philosophy of science and technology will be expected to attend a weekly colloquium held each semester. Scholars from Cornell or other institutions make a formal hour-long presentation, followed by discussion in which all present may participate. There are no course requirements, nor is there any course credit offered. The purpose of the colloquia is to acquaint students with work in the field going on at Cornell and at other institutions and to bring the students into contact with scholars active in the field.

Faculty and Specializations

- R. Boyd: philosophy of science, psychology, epistemology, language, and mind; ethics; social and political philosophy, especially Marxism
- U. Bronfenbrenner: psychology; human development and education; family studies
- J. J. Brumberg: history of American women; history of childhood, youth, and the family; social history of American religion; history of American education; American cultural and intellectual history
- M. Cook: fifth- and fourth-century B.C. Greek political history; Greek historiography, rhetoric, science, and medicine
- T. Fine: comparative probability; inference and decision theory; modeling of chance and uncertainty
- S. L. Gilman: insanity in literature and art; treatments in literature of the Black, of the Jew, and of sexual stereotypes
- C. A. Ginet: philosophy of psychology and of linguistics
- A. Groos: medieval and eighteenth-century German literature
- K. E. Gubbins: molecular thermodynamics of liquid mixtures; phase equilibria; computer simulation studies of liquids; interfacial properties
- M. Harwit: astrophysics; optical transform techniques; history of science and science policy
- H. T. Hodes: philosophy of science and mind; aesthetics; the history of twentieth-century philosophy
- R. Hoffmann: electronic structure of stable and unstable molecules and of transition states in reactions
- K. A. R. Kennedy: biological and forensic anthropology; historical development of biological anthropology; palaeoecology and palaeodemography
- N. Kretzmann: medieval science

- R. L. Liboff: kinetic theory; quantum mechanics
- R. W. Miller: philosophy of the natural and social sciences
- D. W. Nelkin: social factors influencing the conduct of science; the impact of science on modern society
- A. Nerode: recursion theory; model theory; logic and computer science; history of mathematics
- T. F. Peters: nineteenth-century development of the modern building process; suspension bridges; industrial development
- W. B. Provine: history of population genetics; evolutionary theory
- F. H. T. Rhodes: paleontology; evolution; education
- S. Shoemaker: philosophy and psychology
- R. Stalnaker: philosophy of language; epistemology; formal semantics; foundations of probability; philosophy of psychology
- Y. Terzian: radioastronomy; large-scale structure in the universe
- J. H. Weiss: modern European history; social history of technology
- L. P. Williams: origins of field theory in physics; the work of Faraday, Ampere, and Oersted

History of Architecture and Urban Development

Graduate Faculty Representative Christian F. Otto, 140 East Sibley Hall

Major and Minor Subjects (areas of concentration are in parentheses) History of Architecture and Urban Development (history of architecture, history of urban development); Preservation Planning [master's only]

Applicants should have an undergraduate degree in architecture, archaeology, planning, history, history of art, anthropology, or appropriate experience in the field. Other undergraduate degrees may be appropriate and acceptable for the preservation planning major. Applicants residing in the United States must submit GRE scores, and foreign applicants must submit English language competency test scores. Candidates may apply for the Master of Arts or doctoral program in architectural history or urban development history, or for a Master of Arts in preservation planning. Applicants with previous graduate work can be considered for advanced standing. Master's candidates in the history of architecture or urban development programs are required to have reading proficiency in at least one modern language other than English; Ph.D. candidates must have proficiency in two languages other than English before beginning the second year of study. Foreign languages are not required for the master's in preservation planning.

Research, Study, and Fieldwork Opportunities

The field offers many opportunities for enrichment by working with other educational institutions and public or nonprofit agencies. Cornell cooperates with Harvard University in the archaeological exploration of Sardis in Turkey. Qualified students are encouraged to participate as archaeological assistants on this and other excavations in the Mediterranean area. An

overseas program is conducted each summer that can be taken for academic credit. The College of Architecture, Art, and Planning operates a fieldwork program in Washington, D.C., available to students for research and course work throughout the academic year. The preservation planning program offers a fieldwork program in historic preservation serving many upstate New York villages, towns, and cities for the purpose of small-town revitalization and rural preservation. The Department of City and Regional Planning runs a program of teaching and research focusing on urban and regional developments. Students and faculty often work with the summer program in landscape architecture offered by the Field of Landscape Architecture (see p. 72).

Faculty and Specializations

- R. Booth: environmental law
- B. G. Jones: history preservation planning
- M. Kubelik: Italian Renaissance architecture; archeometry; the classical world
- R. D. MacDougall: anthropological methods applied to architecture
- C. F. Otto: histories of Renaissance, baroque, modern, and contemporary architecture and urban design
- 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. W. Stein: preservation planning
- I. R. Stewart: historic preservation planning; American urban history; nineteenth-century landscape design
- M. A. Tomlin: history of preservation movement; documentation methods for preservation
- M. N. Woods: history of American and nineteenth-century European architecture; development of architectural profession and education

History of Art and Archaeology

Graduate Faculty Representative Robert G. Calkins, 35 Goldwin Smith Hall

Major and Minor Subject (areas of concentration are in parentheses) History of Art and Archaeology (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 GRE aptitude test. 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, which has 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 175,000 slides.

Interdepartmental programs are available in archaeology and in medieval studies; descriptive pamphlets 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.

Faculty and Specializations

- American art: T. W. Leavitt
- Ancient art and archaeology: J. E. Coleman, A. Ramage
- Medieval art and architecture: R. G. Calkins
- Modern architecture: T. M. Brown
- Modern art: J. E. Bernstock, T. W. Leavitt, L. L. Meixner
- Oriental art: S. J. O'Connor (Southeast Asian art), M. W. Young (Chinese art)
- Renaissance and baroque art: E. G. Dotson, C. Lazzaro

Hotel Administration

Graduate Faculty Representative Michael Redlin, W-107 Statler Hall

Major Subject (areas of concentration are in parentheses) Hotel Administration (hotel accounting, hotel administration, financial management [minor only], food and beverage management [minor only], marketing [minor only], personnel administration and training [minor only], properties management [minor only])

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. The M.P.S. degree is a professional terminal degree designed to train those who plan to become hotel or restaurant operators and managers.

Candidates for the Ph.D. must have completed a master's or bachelor's degree in hotel administration or related areas. Candidates for the M.S. must have completed the B.S. in hotel administration at Cornell. The Graduate Management Admission Test (GMAT) is required of all applicants to the M.P.S., M.S., and Ph.D. programs.

There are four different approaches to the M.P.S. (H.Ad.) degree, depending on the applicant's prior study: (1) for those with a bachelor's in a field other than hotel administration, 64 credits (a minimum of two years residence) will be required; (2) for those with a B.S. in hotel administration from a school other than Cornell, 48 to 64 credits (one and one-half to two years) will be required; (3) for those with a B.S. in hotel administration from Cornell, 32 credits (one year minimum) will be required; and (4) for those who already hold a master's degree in another field, 48 to 64 credits (one and one-half to two years) will be required. A master's monograph must be presented during the last term of work for this degree.

Each applicant must show evidence of significant experience in the hospitality industry or in a related area. 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 Graduate Office, School of Hotel Administration, Statler Hall.

Admission to the M.P.S. program is granted for fall only. Applications must be filed by February 1; the deadline for submitting supporting documents is March 1. M.S. and Ph.D. degree applicants may apply for either the fall or spring semester. Applications for the spring semester must be filed by September 1, and all supporting documents must be submitted by October 1.

Faculty and Specializations

Accounting and financial management: A. Arbel,
D. C. Dunn, J. J. Eyster, D. Ferguson, A. N. Geller
Communications: D. Jameson
Food and beverage management: S. A. Mutkoski,
P. Rainsford
Food chemistry: M. H. Tabacchi
Hotel management: P. L. Gaurnier
Human resources: F. C. Berger
Law: J. E. H. Sherry
Marketing: C. W. Hart, W. H. Kaven, L. M. Renaghan
Properties management: J. J. Clark, M. H. Redlin

Human Development and Family Studies

Graduate Faculty Representative B. Koslowski, 61
Martha Van Rensselaer Hall

Major and Minor Subjects (areas of concentration are in parentheses) Developmental Psychology (cognitive development, developmental psychopathology, ecology of human development, social and personality development); Human Development and Family Studies (ecology of human development, family studies and the life course)

Graduate students enrolled in this program may choose to organize their courses of studies so as to major formally in one or two broad areas: (a)

Developmental Psychology or (b) Human Development and Family Studies. Within those broad majors (which have some common requirements), students focus their studies by choosing a specific area of concentration. Students may also, if they wish, organize their program to include special emphasis on a particular age span in the life cycle or on a particular context of 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 GRE aptitude test.

The program prepares graduates for careers in academic life, for example, in departments of psychology, sociology, or human development; in research programs of governmental agencies at various levels; and in a range of programs in community agencies and private enterprise. 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 in the context of family and society.

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. The master's, as well as the Ph.D., requires a research thesis. The field requires a predoctoral research project to be completed at the end of the second year of study. Some teaching experience is required for degree candidates. Master's programs ordinarily require two years for completion; doctoral programs, 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. New and continuing students are supported in roughly the same proportions.

Special Facilities and Programs

About one-half of the research in the Field of Human Development and Family Studies is conducted in the departmental laboratories and nursery school; the other half is done off campus. 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 Family Life Development Center is a resource and demonstration center concerned with child abuse and maltreatment. It is possible for students to become involved in research or public service in connection with the center.

The department maintains close relationships off campus with many of the public schools, nursery

schools, day-care centers, youth service agencies, and counseling services in Tompkins County. A great deal of departmental research is conducted in these settings.

The field maintains close relationships with the Fields of African and Afro-American Studies, Psychology, Sociology, and Women's Studies.

Faculty

H. T. M. Bayer, F. Becker, D. J. Bem, S. Bem, W. L. Brittain, U. Bronfenbrenner, J. Brumberg, S. J. Ceci, M. M. Cochran, J. C. Condry, S. W. Cornelius, W. Cross, R. B. Darlington, J. Doris, J. Eckenrode, E. J. Gibson, S. Hamilton, J. S. Harding, E. L. Kain, B. Koslowski, W. W. Lambert, L. C. Lee, H. Levin, B. Lust, P. Moen, M. Potts, H. Ricciuti, B. C. Rosen, R. Savin-Williams, P. Schoggen, G. J. Suci, W. M. K. Trochim, E. Walker

Human Service Studies

Graduate Faculty Representative Robert J. Babcock, N132 Martha Van Rensselaer Hall

Major and Minor Subject (areas of concentration are in parentheses) Human Service Studies (policy analysis and program planning, program evaluation, health services administration, education for human service professionals)

The Field of Human Service Studies offers two types of degrees: the general M.S. and Ph.D., offered through the Graduate School, and the professional M.P.S. (Master of Professional Studies), offered through the College of Human Ecology and the Graduate School. Applicants must submit either GRE (aptitude) or MAT scores.

The field recruits individuals aspiring to, or experienced in, providing direct services to people. Typically students have had volunteer or paid experience in social work, health and mental health programs, and community agencies at local or state levels. Graduates are working in federal, state, regional, and local agencies as executives, program planners, evaluators, policy and budget analysts, and university faculty in professional education programs.

Another program of study is the accredited Sloan Program in Health Services Administration, a two-year curriculum leading to a Master of Professional Studies degree [M.P.S. (Hu. Ec.)]. It is designed to prepare individuals for administrative careers in health care in such settings as hospitals, management consulting firms, private industry, government regulatory and planning agencies, and long-term care, mental health, and social welfare agencies. Applicants must submit either GRE, GMAT, or MAT scores.

The research and public service programs engaged in by faculty and student members of the field reflect this same range of interests and relationships to public agencies. Faculty members continue to conduct research of concern to state and federal legislative bodies, local community agencies, federal and state agencies, and foundations concerned with human services and the quality of life.

Additionally, faculty and students are heavily engaged in programs of continuing education for practicing professionals and staff in public agencies. These programs include in-service training for staffs of county departments of social service for teachers of home economics for vocational education teachers, and for county extension agents.

Graduate Study

Graduate work at Cornell is organized around common-interest fields rather than departments or colleges, and field members may come from any department or unit of the University. The Field of Human Service Studies is located in the Department of Human Service Studies of the New York State College of Human Ecology, one of four statutory colleges of the State University of New York that are part of Cornell University and are located on its Ithaca campus.

The field has no fixed course or credit requirements for a graduate degree. The candidate's program, mapped out with his or her Special Committee, is based on the student's goals and background; it will often consist of a combination of courses from any appropriate source, independent study and research, participation in ongoing research, educational and public service programs, and field experience. When the student has satisfied the plan of study and has passed a qualifying examination, he or she then writes a thesis (a problem-solving project for the M.P.S.) and, on its acceptance by the Special Committee, will receive a degree.

Faculty and Specializations

J. Allen: social welfare policy and services
R. J. Babcock: organizational behavior and career development
M. Barnett: applied anthropology and culture change; development sociology
D. J. Barr: community mental health; group processes; leadership
R. Battistella: public policy issues involving health planning
R. Bruce: adult and community education; international education
H. Burris: adult education; gerontology
S. Clemhout: economics of housing; housing policy; consumer policy
J. L. Compton: extension; community and adult education
J. D. Deshler: adult and community education; group and community processes and change
J. Egner: educational policy and administration
R. Ehrenberg: evaluation methods, economics of public services
J. L. Ford: health policy and health systems planning
J. Gerner: welfare economics and public policy
J. Greene: program evaluation; measurement; motivational processes in learning; research methodology
A. Hahn: community decision making; intergovernmental relationships
D. Hedlund: group development; organizational behavior
I. Lazar: design and evaluation of human service programs; infant and preschool services

J. O. McClain: operations research; decision theory; statistics; computer technology
C. C. McClintock: evaluation and survey methodology; organizational behavior
C. A. McLennan: home economics education; locus of control; teaching strategies
J. Millman: educational measurement and evaluation
M. Minot: home economics education; higher education; instructional design program
P. E. Moen: family; social policy and family impact; work-family linkages
B. J. Mueller: social work education; adult development service systems design
L. Noble: adult learning and development; public service systems
R. Risley: manpower studies; organizational development and behavior; intergroup relations
D. Ritchie: social work; special education; community mental health services
E. F. Roberts: legal and institutional aspects of planning and development
D. Sanjurj: studies of human nutrition; community and international nutrition education
C. Shapiro: social work education
L. C. Street: intergroup relations; criminology; social policy; ethnographic methods
W. Trochim: methodology and evaluation research
E. N. Weiss: health systems analysis; resource allocation; service systems scheduling models
B. L. Yerka: organization and evaluation of informal adult and community educational programs
J. Ziegler: urban social policy; intergovernmental systems

Immunology

Graduate Faculty Representative Robin Bell, Baker Institute

Major Subject (areas of concentration are in parentheses) Immunology (cellular immunology, immunochemistry, immunogenetics, immunopathology, infection and immunity)

The Field of Immunology has a substantial cadre of members and students working in the areas of infection and immunity, cellular immunology, immunogenetics, and immunopathology. There are also members currently carrying out studies in the areas of immunochemistry, membrane biochemistry, developmental immunology, immunoparasitology, and related fields.

There are no tests or language requirements for admission: rather, each student is assessed by the members of the field.

The field offers programs leading to the M.S. and the Ph.D. degrees.

Faculty and Specializations

D. F. Antczak: the major histocompatibility complex
B. A. Baird: molecular immunology; membrane biochemistry
R. G. Bell: immunity to parasitic infections; mucosal immunity
B. W. Calnek: pathogenesis and immunity in avian viral infections

S. G. Campbell: immunity to facultative intracellular bacteria
G. L. Cockerell: tumor immunology
R. H. Cyress: resistance to gastrointestinal helminths
R. R. Diert: genetic regulation of cell surface antigens
J. Fabricant: the pathogenesis of disease of birds
C. M. Fewtrell: cell biology; molecular immunology
J. H. Gillespie: virus infections in cattle and horses
R. H. Jacobson: immunobiology of host-helminth relationships
R. M. Lewis: immunologic mechanisms of tissue injury
J. A. Marsh: developmental immunology
D. D. McGregor: host resistance to intracellular bacteria
N. L. Norcross: secretory immunity to bacterial infection in cattle
F. Noronha: oncovirus immunology
F. W. Quimby: the pathogenesis of autoimmune diseases
E. Racker: role of oncogenes, transforming growth factors, and protein kinases in neoplastic transformation
K. A. Schat: immune responses to Marek's disease virus
D. O. Slauson: the inflammatory response; immunopathology
J. F. Timoney: pathogenesis and immunology of equine streptococcal infections
V. L. Utermohlen: nutrition and immune function
D. W. Wassom: immunogenetics of parasitic infections
W. W. Webb: biophysics of cells
A. J. Winter: secretory immunity; microbial chemistry

Industrial and Labor Relations

Graduate Faculty Representative L. K. Williams, 367 Ives Hall

Major and Minor Subject (areas of concentration are in parentheses) Industrial and Labor Relations (collective bargaining, labor law, and labor history; economic and social statistics; industrial and labor relations problems [restricted to students in other fields]; international and comparative labor relations; labor economics; organizational behavior; personnel and human-resource studies)

Applicants whose native language is English are required to take the GRE aptitude test. 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 a minimum of two semesters, and a total of fourteen courses, eight of which are required. The requirements for this degree are fulfilled by satisfactory performance in these courses.

The final examination for the M.S. 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
A. G. Korman, chairperson; J. Burton, D. E. Cullen,
C. Daniel, R. E. Doherty, M. Gold, J. A. Gross, D. B.
Lipsky, J. O. Morris, P. Ross, N. Salvatore, W. F. Whyte,
J. P. Windmuller

Faculty members specialize in (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, chairperson; I. Blumen, A. Hadi,
L. Stefanski, P. Velleman

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; G. Fields, W. Galenson

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

G. Fields, chairperson; G. R. Boyer, J. Burton,
R. Ehrenberg, W. Galenson, R. Hutchens,
G. Jakubson, O. Mitchell, R. Smith

Scholarly interests of students in labor economics lie primarily in two areas. 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 public programs designed to insure the working population against those risks of living in an industrial society that can be expressed in money terms.

Organizational Behavior

R. N. Stern, chairperson; S. B. Bacharach, S. Barley,
L. W. Gruenfeld, T. H. Hammer, P. Tolbert, H. M. Trice,
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 that are components of such organizations.

Personnel and Human-Resource Studies

R. F. Risley, chairperson; J. Boudreau, V. Briggs,
L. D. Dyer, W. W. Frank, G. Milkovich, F. B. Miller,
S. L. Rynes, W. J. Wasmuth

Personnel and human-resource 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.

Extension

R. Doherty, J. Farley, W. Frank, R. Risley, R. L. Seeber,
W. Wasmuth

International Agricultural and Rural Development

Graduate Faculty Representative Edwin B. Oyer,
261 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 conditions and problems of newly developing economies. While this minor, which is intended for international students as well as for those from the United States, is planned specifically for students majoring in one of the graduate fields in agriculture and life sciences, other qualified students are welcome. Students minoring in this field are encouraged to become proficient in the language that will most likely be useful in their intended area of service.

Students may not minor in this field if they are minoring in fields 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 offers 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 abroad.

Faculty and Specializations

G. S. Abawi: plant pathology (Geneva)
M. Alexander: agronomy
R. Barker: agricultural economics
M. L. Barnett: rural sociology
F. T. Bent: public policy
D. R. Bouldin: agronomy
M. C. Bourne: food science and technology (Geneva)
F. H. Buttel: rural sociology
T. C. Campbell: nutritional sciences
H. R. Capener: rural sociology
W. R. Coffman: plant breeding
R. D. Colle: communication arts
J. L. Compton: education
E. W. Coward, Jr.: rural sociology
E. W. Cupp: entomology

H. R. Cushman: education
 E. C. Erickson: rural sociology
 M. J. Esman: international studies
 R. Everett: animal science
 E. Ewing: botany
 S. Feldman: rural sociology
 D. K. Freebairn: agricultural economics
 P. Garrett: rural sociology
 V. E. Gracen: plant breeding
 D. J. Greenwood: anthropology
 J.-P. Habicht: nutrition
 D. E. Hogue: animal science
 W. K. Jordan: food science
 F. V. Kosikowski: food science
 M. C. Latham: nutritional sciences
 D. J. Lathwell: agronomy
 D. R. Lee: agricultural economics
 W. H. Lesser: agricultural economics
 R. E. McDowell: animal science
 E. McLaughlin: agricultural economics
 R. A. Morse: entomology
 G. W. Olson: agronomy
 E. B. Oyer: international agriculture
 W. R. Philipson: agronomy
 R. L. Plaisted: plant breeding
 T. T. Poleman: agricultural economics
 S. S. Rizvi: food science
 K. L. Robinson: agricultural economics
 T. W. Scott: agronomy
 D. G. Sisler: agricultural economics
 T. S. Steenhuis: agricultural engineering
 K. H. Steinkraus: food science and technology
 (Geneva)
 R. W. Tenney: education
 E. Thorbecke: nutritional science and economics
 H. D. Thurston: plant pathology
 W. M. Tingey: entomology
 N. T. Uphoff: international studies
 P. J. Van Soest: animal science
 A. Van Wambeke: agronomy
 R. J. Wagenet: agronomy
 D. H. Wallace: plant breeding
 M. F. Walter: agricultural engineering
 N. F. Weeden (Geneva): agronomy
 H. C. Wien: vegetable crops
 M. J. Wright: agronomy
 F. W. Young: rural sociology

International Development

Graduate Faculty Representative N. Uphoff, 170 Uris Hall

Major Subject (areas of concentration are in parentheses) International Development (international nutrition, international planning, international population, science and technology policy, development policy)

The field offers graduate training leading to the degree of Master of Professional Studies (International Development)—M.P.S. (I.D.). It provides an interdisciplinary course of study for persons experienced 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—such as population, regional planning,

science and technology policy, or nutrition—and in areas of analysis for implementing objectives—development administration and planning, development economics, development politics, development sociology, or international communication. A specialized concentration in some area of development policy (such as women in development) may serve as the student's concentration with the approval of the graduate faculty representative and the student's adviser. Although applicants should have a strong academic background, excellent professional performance will be given a large weight in evaluating the applicant's admissibility. The field will normally consider only applicants who have at least two years experience in development work. Most applicants will be expected to have complete funding from outside sources. TOEFL and GRE scores should be included with the application.

The degree program consists of at least thirty credits for course work satisfying a residence requirement of 2½ units. Six credits normally are earned for an applied research project. Approximately half of this work will be in one of the four substantive specializations and half in one or more of the areas of analysis. Candidates can expect to complete their degree requirements within eleven to eighteen months. If 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

Population

R. C. Avery, P. S. K. Chi, R. D. Colle, B. Edmonston, C. Hirschman, J. M. Stycos

Regional Planning

P. Brandford, W. W. Goldsmith, B. G. Jones, D. B. Lewis, P. Olpadwala, S. Saltzman, S. Stein

Science and Technology Policy

T. E. Davis, M. J. Esman, D. B. Lewis, W. R. Lynn, J. Svejnar, E. Thorbecke

Nutrition

T. C. Campbell, J. Haas, J.-P. Habicht, M. C. Latham, M. Nesheim, D. A. Roe, D. M. Sanjur, R. Schwartz, D. G. Sisler, L. Stephenson

Methods of Analysis

R. Barker, M. L. Barnett, F. Bent, J. L. Compton, E. W. Coward, Jr., E. Erickson, G. Fields, K. March, N. T. Uphoff, F. W. Young

Professors mentioned under the four substantive specializations may also advise in areas of analysis for international development.

Landscape Architecture

Graduate Faculty Representative Leonard J. Mirin, 114 West Sibley Hall

Major and Minor Subject Landscape Architecture

Two-Year Graduate Program

The two-year Master of Landscape Architecture (M.L.A.) program serves to broaden and enrich undergraduate education in design by providing an expanded educational experience to those who are technically skilled. Applicants are therefore expected to hold a bachelor's degree in architecture or in landscape architecture from a recognized institution.

The objectives of the two-year program are to permit students to conduct research in the multidisciplinary areas relating to landscape architecture and to provide advanced education and training to individuals who decide, upon graduation, to teach, to practice, or to conduct applied research in landscape architecture. To further these objectives, students are permitted considerable flexibility in establishing programs that take full advantage of the teaching and research resources of the University.

Three-Year Graduate Program

Students with bachelor's degrees in areas other than architecture or landscape architecture may enroll in the three-year M.L.A. program. Through an initial curriculum sequence intended to develop basic landscape architecture skills and concepts, the three-year program provides opportunities for students from diverse educational backgrounds to become proficient in landscape design, site construction, graphic communication, plant materials, and other related subject areas necessary to enter the profession fully qualified at the master's level. To provide advanced education and training for those who decide to conduct applied research, to practice, or to teach in landscape architecture, multidisciplinary studies based on an individualized curriculum can be developed under the guidance of an adviser in the Field of Landscape Architecture.

Admission

Applicants should include transcripts of all previous academic performance, two letters of recommendation, and a statement describing the applicant's background and objectives. Portfolios are required for applicants to the two-year program. Examples of work that may illustrate potential for achievement at the graduate level are desirable for applicants to the three-year program. All applicants are strongly encouraged to submit GRE scores. For further information prospective students should write to the graduate faculty representative at the address above.

Curriculum and Requirements

For students enrolled in the two-year program, sixty credits constitute the course work requirement. Two academic years constitute the minimum residence requirement. A student may petition the Graduate School for a maximum of one semester's advanced standing based upon previous education or experience.

Ninety credits, including those for satisfactory completion of the core curriculum courses, fulfill the

course work requirement of the three-year M.L.A. program.

Two-year and three-year M.L.A. program students are required to choose a minor area of concentration. This requires a minimum of fifteen credits of course work and may be chosen from any of the relevant fields in the Graduate School or from subject areas such as the ecologic, economic, social, historical, or legal determinants of landscape architectural design.

In addition to satisfactory completion of course work, requirements for the M.L.A. degree include an approved summer internship and completion of a thesis or final project.

Faculty and Specializations

M. I. Adleman: landscape architecture
D. J. Allee: resource economics
R. S. Booth: environmental law
E. E. Hardy: land-use inventories and remote sensing
T. H. Johnson: landscape architecture
B. G. Jones: urban and regional quantitative analysis and environmental health planning
D. Krall: landscape architecture
A. S. Lieberman: physical environmental quality
L. J. Mirin: landscape architecture
R. G. Mower: ornamental horticulture
C. W. Pearman: architectural design
W. R. Philipson: remote sensing
M. L. Schack: architectural design and urban design
J. P. Shaw: architectural design
S. W. Stein: land-use planning and urban design
R. T. Trancik: landscape architecture and urban design
P. J. Trowbridge: landscape architecture
O. M. Ungers: architectural design

Latin American Studies

Graduate Faculty Representative B. J. Isbell, 206 McGraw Hall

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 before selecting this field as a minor. 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 using 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 in many Latin American countries and will counsel students who have an interest in this field of study.

Faculty

S. Barraclough, T. E. Davis, B. Edmonston, G. Fields, D. K. Freebairn, P. Garrett, W. W. Goldsmith, C. Greenhouse, J. Haas, J. S. Henderson, T. H. Holloway, B. J. Isbell, S. Jackson, E. E. Kenworthy,

T. F. Lynch, R. E. McDowell, O. S. Mitchell,
T. T. Poleman, B. C. Rosen, D. Sanjur, E. M. Santi,
D. F. Solà, J. M. Stycos, M. A. Suñer, H. D. Thurston,
J. Tittler, A. R. Van Wambeke, L. K. Williams,
F. W. Young

Law

Graduate Faculty Representative John Barceló III,
309 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 students who want to increase their knowledge of law by work in a specialized field. The latter is intended for students who want to become legal scholars and to pursue original investigations into the function, administration, history, and progress of law.

The minimum residence requirement for the LL.M. or the J.S.D. is two full terms. But the J.S.D. program normally requires three to four terms. Longer periods may be required. Candidates for either degree are ordinarily expected to concentrate on one legal field and 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 want to become candidates for a degree may, at the discretion of the faculty, be admitted as non-degree candidates.

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 why they want to do advanced graduate work and the particular fields of study they want 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 and any other examinations required by the Special Committee.

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, 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*.

Division Faculty

G. S. Alexander, A. Aman, Jr., J. J. Barceló III,
K. M. Clermont, R. C. Cramton, W. D. Curtiss,
W. T. Dean, T. Eisenberg, C. Farina, A. Gunn,

J. L. Hammond, G. A. Hay, J. A. Henderson,
H. G. Henn, R. A. Hillman, S. L. Johnson, R. B. Kent,
D. L. Lyons, P. W. Martin, D. A. Oesterle, R. K. Osgood,
L. I. Palmer, E. F. Roberts, Jr., F. F. Rossi, S. J. Schwab,
J. A. Siliciano, G. J. Simson, R. S. Summers,
G. Thoron, C. W. Wolfram, J. T. Younger, F. C. Zacharias

Linguistics

Graduate Faculty Representative L. H. Babby, 310
Morrill Hall

Major Subjects General Linguistics, Teaching of English as a Second Language (M.S. degree only)

Minor Subjects Applied Linguistics, English Linguistics, Germanic Linguistics, Indo-European Linguistics, Phonological Theory, Romance Linguistics, Semantics, Slavic Linguistics, Sociolinguistics, Syntactic Theory

GRE scores are required of all applicants to the Field of Linguistics.

In addition to the M.A. and Ph.D. degrees, an M.S. is offered in the teaching of English as a second language. This is a two-year program, and applicants should be sufficiently well prepared on admission to begin research on the thesis by the end of the first term of residence.

The assure that all Ph.D. students receive a firm grounding in current linguistic theory, the field requires a core of eight specific courses. Exemptions are granted on an individual basis. Three core courses are required for the M.A.

Candidates for the M.A. and M.S. 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, at least one of which must be either French, German, or Russian. The requirement may be satisfied in French, German, and Russian by taking the College Entrance Examination Board test and achieving a score acceptable to the linguistics faculty. In other languages the requirement may be satisfied by special examination administered by an appropriate member of the faculty.

For the Ph.D., a qualifying examination in the spring of the first year is required in addition to the examinations required by the Graduate School.

The field offers a wide variety of courses in theoretical and applied linguistics, as well as an exceptionally broad spectrum of courses dealing with the history and structure of particular languages.

Specialization in linguistics is provided by several other fields of the Graduate School. Relevant minor subjects are offered by the Fields of Asian Studies, Classics, Germanic Studies, Near Eastern Studies, Psychology, Romance Studies, and Slavic Studies. All of those offerings are found in this *Announcement* under the various fields.

Faculty and Specializations

- L. H. Babby: Slavic linguistics; syntactic theory; Turkish
J. S. Bowers: transformational grammar; syntax and semantics
E. W. Browne: Slavic linguistics; Balkan languages; linguistic theory; language pedagogy
G. Chierchia: general linguistics
G. N. Clements: phonology; West African and Bantu languages and linguistics; syntax and morphology
J. W. Gair: South Asian and general linguistics; Sinhala
J. E. Grimes: general linguistics; discourse; phonetics; computational linguistics; indigenous languages of the Americas
W. E. Harbert: Germanic linguistics and historical syntax
C. T. J. Huang: general linguistics
F. E. Huffman: Southeast Asian language and linguistics; field methods
J. Jasanoff: Indo-European, Germanic, and historical linguistics
R. B. Jones: Southeast Asian language and linguistics; comparative and historical linguistics
E. H. Jorden: Japanese language and linguistics; language pedagogy
G. B. Kelley: sociolinguistics; Dravidian linguistics; Hindi
H. L. Kufner: Germanic linguistics; German; applied linguistics
R. L. Leed: Russian phonology; historical linguistics; language pedagogy
B. Lust: language acquisition and linguistic theory
S. McConnell-Ginet: general linguistics; semantic theory; sex differentiation in language; English as a second language
J. McCoy: Chinese and Japanese linguistics; Chinese dialects
G. M. Messing: Indo-European; classical languages; Balkan philology
J. S. Noblitt: French linguistics; second language acquisition; applied linguistics
A. Nussbaum: general linguistics
C. Rosen: syntactic theory; syntactic universals and relational grammar; historical linguistics and Romance linguistics; Italian
D. F. Solá: language policy; sociolinguistics; syntactic theory; Quechua language
G. Suci: psycholinguistics and language acquisition
M. Suñer: Hispanic linguistics; general and applied linguistics; Spanish
F. van Coetsem: Germanic linguistics; Dutch; language contact
L. R. Waugh: French and general linguistics; semantics; Jakobsonian theory
J. U. Wolff: Malayo-Polynesian and Philippine languages and linguistics

Management

Graduate Faculty Representative Dick R. Wittink, 506 Malott Hall

Major and Minor Subjects (areas of concentration are in parentheses) Business Administration (accounting, business and public policy, finance, managerial economics, marketing, organizational

theory and behavior, production and operations management, quantitative analysis for administration)

The most desirable preparation is strong undergraduate work in such relevant fields as economics, engineering, mathematics, psychology, sociology, or one of the other physical or social sciences. Students are admitted directly from a bachelor's degree program or after a distinguished record in an M.B.A. or other master's program. A knowledge of mathematics at least through calculus is essential. Scores from the GREs or the GMAT are required. Students may not register for an M.A. or M.S. degree in this field; those desiring a master's degree should examine the *Announcement of the Graduate School of Management*.

Subject Descriptions

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 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.

Management 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.

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 on the decision-making process in the management of marketing organizations.

Organizational 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.

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.

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.

Faculty

M. Y. Abolafia, R. M. Battistella, F. T. Bent, H. Bierman, L. K. C. Chan, R. W. Conway, T. R. Dyckman, J. A. Elliott, E. S. Flash, J. E. Hass, R. Hilton, R. A. Jarrow, D. M. Krackhardt, R. C. Lind, A. K. McAdams, J. O. McClain, D. Morse, M. O'Hara, G. Oldfield, L. Orman, V. R. Rao, S. Smidt, R. Smiley, R. J. Swieringa, R. Thaler, L. Joseph Thomas, E. N. Weiss, D. R. Wittink

Materials Science and Engineering

Graduate Faculty Representative David Kohlstedt, 329 Bard Hall

Major Subject (areas of concentration are in parentheses) Materials Science and Engineering (materials and metallurgical engineering, materials science)

Students from any undergraduate engineering or physical science program may be accepted. Applicants from outside the United States or Canada must submit GRE scores. On request the graduate faculty representative can waive this requirement.

Research and Study Opportunities

The following is a list of current areas of advanced study and research. The materials of interest include metals, semiconductors, ionic solids, ceramics, polymers, glasses, and glassy metals.

Development of advanced experimental techniques: high-resolution electron microscopy, X-ray, high pressure, crystal growing, purification methods

Electrical and magnetic behavior: semiconductors, conduction in oxides and amorphous materials, magnetic domain wall motion, properties of layered structures, fast-ion conductors

Geological materials: mechanical properties, effects of pressure and environment on diffusion

Helium back scattering: electron-beam induced current microscopy, scanning transmission electron microscopy, deep level transient capacitance spectrometry

High-pressure studies: creep, diffusion, elastic constants, equation of state, synthesis, electrical properties, metallic hydrogen

High-temperature materials: composite materials, refractory metals and alloys, sintering of ceramics

Imperfections in solids: point defects, dislocation mechanics, planar defects in silicon, defect interactions, radiation damage, grain boundaries, structural studies of polymers, diffraction studies with synchrotron radiation

Mechanical behavior: plastic deformation and the strength of solids, fracture, embrittlement phenomena, anelasticity, crazing and fracture of polymers, mechanical behavior of metallic glasses

Microprocessing: submicron particle production, submicron grain polycrystalline production, submicron lamellar structures, very thin films, ion implantation

Nuclear materials: reactor materials, radiation damage, mechanical properties

Phase transformations: solidification, precipitation, martensite, phase decomposition during sintering, nonstoichiometry in ceramic systems, silicide formation, pulsed beam induced phase transformations in semiconductors

Solid-state reactions: reactions in oxides and silicates, internal oxidation and reduction

Surface structure and reactions: solid-liquid and solid-gas interfaces, surface diffusion, low-energy electron diffraction, oxidation, segregation, catalysis, secondary electron spectroscopy, electron tunneling spectroscopy and synchrotron radiation photoelectron spectroscopy, reduction of oxides by gases

More-detailed information about course programs and research areas is available on request.

A strong catalyst for the materials research activities at Cornell has been provided by the Materials Science Center, which provides substantial financial assistance to 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; there is less emphasis on research. For further information, see *Graduate Study in Engineering and Applied Science at Cornell*.

Faculty

D. G. Ast, W. A. Bassett, B. W. Batterman, J. M. Blakely, C. B. Carter, C. Cohen, D. Grubb, E. W. Hart, H. H. Johnson, D. L. Kohlstedt, E. J. Kramer, C. Y. Li, J. Mayer, R. Merrill, S. L. Phoenix, R. Raj, T. N. Rhodin, A. L. Ruoff, S. L. Sass, D. N. Seidman, B. M. Siegel, J. Silcox, F. O. Slate, M. O. Thompson, W. W. Webb, E. D. Wolf

Mathematics

Graduate Faculty Representative S. Lichtenbaum, B-4 White Hall

Major and Minor Subject 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 on 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 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.

It is strongly recommended that applicants take the GREs (including the aptitude test and the advanced test in mathematics) in time for the scores to be reported by February 1.

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 graduate faculty representative. A detailed list of the research interests 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.

Special Masters There is a course-work master's degree in computer science available to students in the Ph.D. program in mathematics. For details, contact the graduate faculty representative.

Faculty

I. Berstein, L. J. Billera, J. H. Bramble, K. S. Brown, L. D. Brown, S. U. Chase, M. M. Cohen, R. Connelly, R. K. Dennis, R. T. Durrett, E. B. Dynkin, C. J. Earle, R. H. Farrell, M. E. Fisher, L. Gross, J. Guckenheimer, A. E. Hatcher, D. W. Henderson, P. J. Holmes, J. H. Hubbard, J. T. Hwang, P. J. Kahn, H. Kesten, A. W. Knapp, S. Lichtenbaum, G. R. Livesay, W. L. Lok, R. Lubarsky, G. Ludford, M. D. Morley, A. Nerode, L. E. Payne, R. A. Platek, D. Ramakrishnan, A. Rosenberg, O. S. Rothaus, A. H. Schatz, S. Sen, R. Shore, B. Speh, F. L. Spitzer, R. S. Strichartz, M. E. Sweedler, K. Vogtmann, L. Wahlbin, J. E. West

Mechanical Engineering

Graduate Faculty Representative Leigh Phoenix, 106 Upson Hall

Major and Minor Subject (areas of concentration are in parentheses) Mechanical Engineering (biomechanical engineering, combustion, energy and power systems, fluid mechanics, heat transfer, materials and manufacturing engineering, mechanical systems and design)

Applicants should have the equivalent of an accredited undergraduate curriculum in the area of their major work. Promising applicants with deficiencies may be required to make up the deficiencies. All domestic applicants are strongly urged to submit the results of the GRE aptitude and advanced tests. Other applicants

are required to submit GRE aptitude and advanced test results.

The M.S. and Ph.D. programs require submission of a thesis. These programs provide an advanced level of training suitable for pursuing careers in research and development, education, or advanced engineering analysis and design. A reading knowledge of French, German, or Russian is required of Ph.D. candidates (in addition to their native language). Ph.D. candidates may be asked to take a qualifying examination in addition to the examinations required by the Graduate School.

Teaching and research assistantships are available to students in the M.S. and Ph.D. programs. The John McMullen Graduate Fellowship and the Edgar J. Meyer Scholarship are also available.

Professional Degree

The field of mechanical engineering offers the professional degree of Master of Engineering (Mechanical). The M.Eng. (Mechanical) degree program has a thirty-credit curriculum and requires an engineering design course rather than a research thesis. The program is intended primarily for persons who seek a high level of competence in current technology and engineering design and who plan to practice engineering in industry or professionally. Students concentrate in one of the areas within the field. The program may also serve as the first step toward the doctorate for persons who are inclined toward the technological aspects of advanced engineering.

Faculty and Specializations

Biomechanical Engineering Biomechanics, emphasizing structural analysis, computer-aided design, lubrication of joints and the dynamics of the musculo-skeletal system. D. L. Bartel, J. F. Booker, D. L. Taylor.

Combustion Research is concentrated on turbulent combustion, advanced diagnostic techniques, chemical kinetics, spectroscopy, fuel pyrolysis, fluidized-bed combustion, droplet combustion, generation of air pollutants, gas turbine combustors, engine combustion, and alternative fuels. C. T. Avedisian, P. C. T. de Boer, F. C. Gouldin, S. B. Pope, E. L. Resler, Jr.

Energy and Power Systems This category includes studies of the transformation, transport, and utilization of energy, and associated environmental interactions. Specific topics include energy policy studies, power-plant cycles and siting, dry-cooling technology, geothermal energy, and energy-efficient propulsion systems. P. L. Auer, B. Conta, F. K. Moore, E. L. Resler, Jr., D. G. Shepherd.

Fluid Mechanics Topics included in this area are computational fluid mechanics, turbulence and turbulent flows, meteorological fluid dynamics, rotating fluids, physical oceanography, cooling-tower aerodynamics, geological and geothermal flows, and noise generation. D. A. Caughey, A. R. George, F. C. Gouldin, S. Leibovich, J. L. Lumley, F. K. Moore, S. B. Pope, S.-F. Shen, D. G. Shepherd, K. E. Torrance, Z. Warhaft.

Heat Transfer Topics of current interest include freezing, evaporation, boiling, conduction, free convection, and mixed convection. Applications include heat rejection to the environment, geophysical heat transfer, air-cooled heat exchangers, cooling of electronic components and enhanced heat transfer. C. T. Avedisian, F. K. Moore, K. E. Torrance.

Materials and Manufacturing Engineering Research is concerned with the analysis and selection of materials and manufacturing operations. Studies include failure in composite materials, injection molding processes, computer-aided design of systems, numerical control of machine processes, materials forming, and friction welding. P. R. Dawson, M. Leu, S. L. Phoenix, P. Schwartz, K. K. Wang.

Mechanical Systems and Design This area is concerned with the design, analysis, and manufacture of devices, machines, and systems. Topics under study are reliability, optimization, finite element analysis, computer-aided design, vehicle dynamics, vibrations, control systems, robotics, lubrication, and dynamic analysis of bearings. D. L. Bartel, J. F. Booker, M. Leu, R. M. Phelan, S. L. Phoenix, D. Taylor, R. L. Wehe.

Medieval Studies

Graduate Faculty Representative Arthur Groos, 77 Goldwin Smith Hall

Major and Minor Subject (areas of concentration are in parentheses) Medieval Studies (medieval art, medieval history, medieval literature, medieval music, medieval philology, 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 traditional fields.

Medieval literature and philology may be studied in the following languages: Celtic, English, Germanic, Latin, Old Norse, Romance, Semitic, or Slavic.

Although certain requirements are absolute (such as 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 ideally should precede graduate concentration in this field. All applicants are strongly urged to take the GRE aptitude test and an appropriate advanced test, if such exists.

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

Further information concerning the Field of Medieval Studies is given in the field's brochure, which can be obtained by writing to the graduate faculty representative, 77 Goldwin Smith Hall.

Faculty and Specializations

B. B. Adams: medieval drama
F. M. Ahl: Latin epic
C. M. Arroyo: medieval Spanish language and literature

R. G. Calkins: medieval art and architecture
A. M. Colby-Hall: Old French language and literature
R. T. Farrell: Old English language and literature; English philology; medieval archaeology
A. B. Groos: medieval German language and literature
T. D. Hill: Old English language and literature
J. Jasanoff: Germanic, Celtic, and Indo-European philology
J. J. John: Latin paleography, medieval history
R. E. Kaske: Middle English language and literature
N. Kretzmann: medieval philosophy
G. M. Messing: medieval Latin language and literature
J. M. Najemy: late medieval Italian and Renaissance history
D. S. Powers: Islamic studies
D. M. Randel: medieval music
B. Tierney: medieval history; canon law
F. van Coetsem: Germanic philology
W. Wetherbee: medieval Latin and English literature

Microbiology

Graduate Faculty Representative Robert P. Mortlock, 310 Stocking Hall

Major and Minor Subject Microbiology (see also the Field of Veterinary Medicine)

Applicants should have preparation in general chemistry at an intermediate level, organic chemistry, physics, and introductory courses in the biological sciences. In addition, training in physical chemistry and calculus is desirable.

Although 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 GRE 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, W. C. Ghiorse, E. P. Greenberg, S. H. Zinder
Food microbiology: C. Batt, Y. D. Hang,* R. Ledford, D. F. Splittstoesser,* J. R. Stamer,* K. H. Steinkraus,* P. J. VanDemark
Industrial fermentations and bioengineering: R. K. Finn, Y. D. Hang,* M. L. Shuler, K. H. Steinkraus*
Marine microbiology: E. P. Greenberg
Metabolic control: J. Gibson, P. J. VanDemark, S. A. Zahler
Microbial ecology: M. Alexander, W. C. Ghiorse, J. Gibson, E. P. Greenberg, R. E. MacDonald, J. B. Russell, S. H. Zinder
Microbial genetics: S. A. Zahler
Microbial nutrition: P. J. VanDemark
Microbial physiology: J. Gibson, E. P. Greenberg, R. P. Mortlock, J. B. Russell, P. J. VanDemark, S. H. Zinder
Microbiology of wastes: S. H. Zinder

Molecular biology: R. E. MacDonald
 Molecular genetics: A. A. Szalay, S. A. Zahler
 Pathogenic bacteriology: G. M. Dunny
 Plant pathogens: S. Beer
 Prokaryotic cytology: W. C. Ghiorse
 Prokaryotic photosynthesis: J. Gibson
 Rumen microbiology: J. B. Russell
 Soil microbiology: M. Alexander

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

Music

Graduate Faculty Representative Edward Murray,
 311 Lincoln Hall

Major and Minor Subjects (areas of concentration are in parentheses) *For the M.A. and Ph.D.:*
 Musicology, Theory of Music (M.A. major only), Musical Composition (minor only), Music Performance (minor only). *For the M.F.A. and D.M.A.:* Music (composition, eighteenth-century performance practice)

All applicants must take a test of musicianship as well as a written music history and analysis examination. Further information may be obtained from the office of the Department of Music. Applicants must also submit scores of the GRE aptitude test (the GRE advanced test in music is optional), and a term paper or musical composition.

For the M.F.A., and the D.M.A., the field requires a reading knowledge of French or German; for the M.A. and the Ph.D. in musicology, a reading knowledge of both is required.

Program and Facilities

The graduate program at Cornell coordinates musical composition, scholarship, and performance. Under the supervision of their Special Committees, students create individual programs of study in accordance with their interests and abilities. While mastering a professional discipline, they are expected to continue to develop broad interests in music and related fields. Doctoral studies in musicology may emphasize music theory or ethnomusicology. The performers in the field specialize in historically authentic performance practice.

The Music Library, housed in Lincoln Hall, has an excellent collection of the standard research tools; its holdings consist of approximately 60,000 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 and a two-manual Hubbard harpsichord are available for practice; a Dowd harpsichord, a replica of a 1784 Stein fortepiano, a replica of an 1820 Graf

fortepiano, and a Bösendorfer concert grand piano are reserved for advanced students and 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, and its equipment is steadily increasing.

The Department of Music and the Faculty Committee on Music sponsor more than eighty concerts each year 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
 M. Hatch: ethnomusicology; history and theory of Indonesian music; gamelan orchestra
 J. Hsu: literature and technique of the viols and violoncello
 K. Husa: composition; orchestration; conducting
 S. Monosoff: violin; baroque violin; chamber music; performance practice
 E. Murray: theory; twentieth-century music
 R. Parker: nineteenth century opera and instrumental music
 D. Randel: medieval and Renaissance music
 T. Sokol: choral music; conducting; performance styles
 S. Stucky: composition; twentieth-century music; tonal and atonal theory
 J. Webster: eighteenth- and nineteenth-century music; theory of tonal music; history of theory
 N. Zaslav: seventeenth- and eighteenth-century music; 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
 P. Friedheim: nineteenth- and early twentieth-century music
 W. Klentz: baroque music; performance practice; music aesthetics
 E. Laderman: composition
 H. B. Lincoln: sixteenth-century music; computers in music research
 A. Mitchell: music theory
 J. Rothgeb: music theory, analysis

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

Natural Resources

Graduate Faculty Representative W. Youngs,
 8C Fernow Hall

Major and Minor Subject (areas of concentration are in parentheses) Natural Resources (aquatic science, fishery science, forest science, resource policy and planning, wildlife science)

Applicants should be well prepared in biological sciences; a strong background in physical sciences and a working knowledge of statistical methods are highly desirable. The GRE aptitude test is typically required.

To concentrate in resource policy and planning, a student should have previous training in a discipline that can be used in focusing on natural resources problems; also, professional job experience is normally expected.

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 hardwood 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. Facilities are available for short-term housing, teaching, and research.

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

The Fishery Laboratory, located a half mile from the campus, contains 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 larval-fish building, and a workshop. There are ten ponds on the laboratory grounds for research on warmwater fishes in seminatural conditions. Boats are available for use in aquatic ecology and fishery studies on the Finger Lakes. Two well-equipped laboratories are available for limnological studies.

Wildlife research facilities are located one mile from the campus at the Richard E. Reynolds Game Farm of the New York State Department of Environmental Conservation. The Wildlife Ecology Laboratory houses equipment for physiological and nutritional studies and provides laboratory-office space for faculty and graduate students interested in the study of ecology, behavior, and genetics of vertebrates.

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 Unit

The New York Cooperative Fish and Wildlife Unit combines federal, state, and University assets to facilitate advanced training and research. The research unit staff participates in the department's teaching and advising program and conducts research on a variety of aquatic and terrestrial subjects. The unit leader and two assistant leaders are members of the graduate faculty and devote most of their efforts to graduate research and training.

Faculty and Specializations

- D. J. Allee: resource economics; resource policy and planning
- R. A. Baer, Jr.: environmental values; land ethics
- H. B. Brumsted: community and regional problems; environmental education, outdoor recreation; wildlife values, use, policies
- T. J. Cade: behavior and ecology of birds
- T. J. Fahey: dynamics of forest ecosystems
- J. L. Forney: ecology of freshwater fishes
- T. A. Gavin: wildlife management and population biology of birds and mammals
- J. W. Gillett: ecotoxicology; microcosm technology; risk assessment
- S. P. Gloss: fisheries biology; aquatic ecology
- J. W. Kelley: natural resources management and extension education
- C. C. Krueger: fisheries management; population genetics; stream ecology
- J. P. Lassoie: nonindustrial uses of forest lands; woodlot management; forest ecology; tree physiology
- R. A. Malecki: waterfowl biology and wetland ecosystems
- R. J. McNeil: international resource problems; ethics, attitudes, values, and life-styles; big-game ecology
- A. N. Moen: physiology, nutrition, and behavior of free-ranging animals
- R. T. Oglesby: comparative limnology and management of aquatic resources
- D. Pimentel: environmental policies; energy and land resources; ecosystem management
- M. E. Richmond: reproduction and population biology of mammals and birds; terrestrial ecology
- D. A. Webster: ecology and population dynamics of trout and salmon
- B. T. Wilkins: natural resource policies; outdoor recreation; management of marine resources
- W. D. Youngs: fishery biology

Near Eastern Studies

Graduate Faculty Representative D. Owen, 372 Rockefeller Hall

Major and Minor Subject (areas of concentration are in parentheses) Near Eastern Studies (Arabic

and Islamic, Assyriology, biblical history and archaeology, Dead Sea Scrolls, Hebrew Bible, Judaic studies, Near Eastern history and archaeology, Semitic languages and literatures)

Near Eastern studies at Cornell is 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 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 Near Eastern and biblical studies; (2) ancient, medieval, and modern Jewish history; (3) ancient and medieval Arabic literature; and (4) Hebrew language and literature.

Candidates for the Ph.D. degree will be expected to demonstrate mastery in the language or languages of the main texts that 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 about linguistic requirements. All applicants to the field will be expected to have at least three years of undergraduate study of one Semitic language or the equivalent and to have taken the GRE aptitude test.

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

Faculty and Specializations

- M. F. Collins: Hebrew and Aramaic; Hebrew Bible; literature of Judaism in late antiquity; rabbinic literature
 S. Katz: Jewish history
 S. E. Mehrez: Arabic language and literature; Islamic
 D. I. Owen: ancient Near Eastern history and archaeology; Assyriology; biblical history and archaeology; maritime history and archaeology
 D. S. Powers: Arabic, Islamic law and Islamic history

Neurobiology and Behavior

(See also the listing under Medical Sciences.)

Graduate Faculty Representative Paul Sherman, W309 Seeley Mudd Hall

Major and Minor Subjects (areas of concentration are in parentheses) Behavioral Biology (ethology); Neurobiology (cellular and molecular neurobiology, neuroanatomy, neurochemistry, neuropharmacology, neurophysiology, sensory physiology)

Applicants must present scores from the GRE aptitude test and one of the advanced science tests. Students can be considered for Cornell fellowships, and for teaching and research assistantships and traineeships in cellular and molecular neurobiology. Deadline for

application to the field is February 1. Early application is recommended; to be eligible for a Cornell fellowship, applications are due by January 1. The field discourages the application of Cornell graduates and accepts students from Cornell only under special circumstances. (Please consult with the graduate faculty representative.)

The field has no language requirement, but such a requirement is frequently imposed by the student's Special Committee.

In addition to the normal requirements of the Graduate School, the field requires for the Ph.D. degree one year of teaching experience, a written qualifying examination at the end of the first year of study, and an orientation meeting with the Special Committee within the first three semesters at Cornell. The field also requires each student to give a publicly announced seminar as part of the thesis defense for both the M.S. and Ph.D. degrees.

Faculty and Specializations

Members of the faculty will be especially interested in directing research in the areas mentioned below. Prospective students may want to correspond with staff members whose interests are most closely related to their own before they apply.

- K. Adler: photoreception and orientation of vertebrates; behavior of amphibians and reptiles
 A. H. Bass: evolution of nervous system; neuroanatomy; sexual differentiation of the brain
 R. Campenot: developmental neurobiology; chemical control of axon growth
 R. Capranica: animal communication; sensory neurobiology
 T. deVoogd: steroid actions in brain; development of brain and behavior
 G. C. Eickwort: arthropod behavior; evolution of social and nest-building behavior
 T. Eisner: chemical communication; chemical ecology; insect behavior and physiology
 S. T. Emlen: animal orientation systems; adaptive strategies of vertebrate social behavior
 B. Finlay: sensory physiology; visually guided behavior; neuroembryology
 E. L. Gasteiger: electrical activity of the vertebrate nervous system; neural nets
 B. Halpern: sensory physiology; chemoreception
 R. Harris-Warrick: neurochemistry; neurophysiology
 C. Hopkins: animal communication; neuroethology; mechanisms of species recognition in electric communication
 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; hormones and behavior; human ethology
 E. Loew: visual ecology of vertebrates/invertebrates; retinal electrophysiology; microspectrophotometry of visual pigment
 W. McFarland: sensory ecology; vertebrate visual systems
 R. Oswald: neurotransmitter receptors; ion channels

- T. R. Podleski: neurochemistry; membrane physiology
 E. Regan: vertebrate social behavior; hormonal bases of reproductive and aggressive behavior
 W. Roelofs: insect pheromones; identification and behavioral responses in the field and in the laboratory
 M. Salpeter: neurocytology; synaptic mechanisms; developmental neurobiology; neurotropic phenomena; electron microscopy and EM autoradiography
 P. Sherman: behavioral ecology
 D. N. Tapper: sensory physiology; receptor and central integration processes
 C. Walcott: animal orientation and navigation; animal communication; magnetic orientation in homing pigeons
 G. Weiland: neuropharmacology; receptor mechanisms

Nuclear Science and Engineering

Graduate Faculty Representative David D. Clark,
 105 Ward Laboratory

Major and Minor Subject (areas of concentration are in parentheses) Nuclear Science and Engineering (nuclear engineering, nuclear science)

Nuclear science and engineering is concerned with the understanding, development, and application of the science of nuclear reactions and radiations. The graduate programs at Cornell allow specialization in basic nuclear science, in applied nuclear engineering, or in a combination of the two. Both fission and fusion science and engineering are available.

Three graduate degree programs are offered. The Master of Engineering (Nuclear) is a professional degree; the M.S. and Ph.D. degrees are intended for those who plan to pursue research or teaching careers.

A bachelor's degree in science or engineering, including courses in advanced calculus, thermodynamics, and atomic and nuclear physics, is required. Students with less preparation may be admitted but should expect to take longer to complete degree requirements. Applicants are urged, but not required, to submit GRE aptitude test scores.

For the Ph.D., a reading knowledge of one language other than English is required.

Financial aid, including teaching or research assistantships, 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 by January 15 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.

Prospective students in the Master of Engineering (Nuclear) degree program who want to apply for scholarship aid should obtain the appropriate form from the chairperson, Graduate Professional Engineering Programs.

Research Opportunities

The M.S. and Ph.D. programs are oriented toward research and require completion of a thesis as well as course work. Candidates for one of these degrees choose either nuclear science or nuclear engineering as their major subject; because each student plans an individual program in consultation with the faculty members of his or her Special Committee, there are no detailed degree requirements. This approach, long a tradition of graduate study at Cornell, is well suited to interdisciplinary fields such as nuclear science and engineering. Areas of concentration may be in any related engineering or science field. Independent thesis research and formal and informal interactions with staff members and other students are vital parts of the program.

The programs permit emphasizing a variety of specializations such as experimental nuclear physics, nuclear instrumentation, radiation protection, nuclear environmental engineering, plasma physics, fusion reactor engineering, and radiation damage.

Examples of current research in nuclear engineering are the computer modeling of reactor systems for the investigation of operational, anticipated and accident transients in liquid-metal-cooled fast breeder reactors and light-water-moderated reactors, and the development of models for determining failure probability of reactor systems.

Research groups in nuclear science are currently pursuing studies of nuclear structure, interaction of radiation with matter, activation analysis, and radiation chemistry.

Current examples of nuclear structure research are experimental investigation of short-lived nuclear isomeric states—in particular the "shape isomers" associated with the fission barrier—using instrumentation invented and developed at Ward Laboratory. There is also a program of studies of short-lived fission products that uses facilities at Brookhaven National Laboratory.

In addition, studies of atomic processes relevant to astrophysical and laboratory plasmas are being carried out. An electron beam ion source producing low-energy multiply charged ion beams is used in experiments to investigate, for example, electron charge transfer to bare hydrogen- and helium-like keV/nucleon ions of carbon, nitrogen, and oxygen.

Experimental facilities of the Ward Laboratory include (1) the TRIGA reactor, with a steady-state power of 500 kilowatts and a pulsing capability of up to 1,000 megawatts, for activation analysis and nuclear physics; (2) the Cornell Critical Facility, a "zero-power reactor" of very versatile design for basic studies in reactor physics and dynamics; (3) the Gamma Cell, a shielded cell with a nominal 10,000-Curie ^{60}Co gamma ray source, for radiation chemistry and radiation damage studies.

The scientific feasibility of fusion power is likely to be demonstrated within the next few years; at Cornell a program in fusion technology that will complement the existing strong plasma physics program has begun.

Most of the plasma physics research at Cornell is conducted through the Laboratory of Plasma Studies,

which coordinates and facilitates the work of faculty members from several graduate fields. Cornell is recognized as the leading university in the production and application of relativistic electron beams and intense ion beams to controlled fusion. Specific projects now under way are concerned with the production of magnetic-field configurations particularly suited for plasma confinement by electron and ion beams, and the use of ion beams for inertial confinement fusion.

Fusion technology combines conventional nuclear engineering with knowledge about plasma physics and other technologies that may be required for the development of fusion reactors. For example, considerations such as neutron transport and radiation-induced material damage must be incorporated into a fusion-reactor design in such a way as to be compatible with the physics of the reacting plasma.

Research is under way at Cornell on the effects of neutral hydrogen and helium bombardment of the "first wall" of a fusion reactor. Facilities available for research in fusion physics and technology not previously described include a variety of magnetic-confinement systems and intense-particle-beam generators. The latter category includes pulsed-power generators with powers from 10^{10} to 5×10^{11} watts for pulse durations of 10^{-7} seconds. Electron beams of 10^{11} watts and proton beams in excess of 10^{10} watts are routinely produced by these generators.

Professional Degree

The two-term curricular program leading to the degree of Master of Engineering (Nuclear) is intended primarily for those 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.

Faculty and Specializations

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

Nutrition

Graduate Faculty Representative L. D. Wright, 145 Savage Hall

Major and Minor Subject (areas of concentration are in parentheses) Nutrition (animal nutrition, clinical nutrition, foods, general nutrition, human nutrition, international nutrition, nutritional biochemistry)

An adequate background in chemistry, biology, physics, and mathematics is essential for advanced study in nutrition, particularly in areas involving laboratory experimentation. 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 some deficiencies after they have been admitted to the graduate program. GRE aptitude test scores are required by the field; advanced test scores in chemistry or biology are recommended.

Candidates for the M.S. must satisfy requirements in the major subject and one area of concentration outside of the field. Candidates for the Ph.D. must satisfy requirements in the major subject and two areas of concentration; only one of the areas of concentration may be selected from within the field. Candidates for the M.N.S. degree must complete a two-year program consisting of study at the University and affiliated clinical sites. All degree programs require a thesis; 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 constitute 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 and Poultry and Avian 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 on his or her 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 that provide opportunity for field experience in the United States or abroad. Students seeking training in foods have the opportunity to apply principles and techniques of organic chemistry, biological science, and microbiology to problems dealing with human food. As a part of their training, graduate students may be expected to assist in teaching.

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 using humans, lower animals, and microorganisms as experimental models. Faculty members in the field have ongoing research programs relating nutrition to humans, as well as to laboratory animals, companion animals, and food-producing animals. Faculty members, grouped by general categories of their major interests, are listed below.

Foods: G. Armbruster, C. Bisogni, B. Lewis, D. Miller, N. Mondy, R. Parker, D. M. Sanjur

Human nutrition studies, including clinical, community, and international nutrition: T. C. Campbell, M. Devine, A. Gillespie, J. D. Haas, J.-P. Habicht, M. C. Latham, D. A. Levitsky, M. A. Morrison, C. M. Olson, K. Rasmussen, D. A. Roe, D. M. Sanjur, R. Schwartz, L. Stephenson, M. Stipanuk, V. Utermohlen-Lovelace

Animal nutrition: B. J. Apgar, W. Arion, R. E. Austic, D. Bauman, A. Bensadoun, R. D. Boyd, L. E. Chase, G. F. Combs, M. Devine, J. M. Elliot, D. Fox, H. F. Hintz, D. E. Hogue, F. A. Kalfelz, M. N. Kazarinoff, L. D. Krook, D. A. Levitsky, B. A. Lewis, C. McCormick, D. Miller, M. A. Morrison, M. C. Nesheim, J. T. Reid, R. Schwartz, C. Sniffen, M. Thonney, D. R. Van Campen, J. Van Soest, R. G. Warner, R. H. Wasserman, M. Watford, R. J. Young, D. Zilversmit

Operations Research

Graduate Faculty Representative David C. Heath, 318 Upson Hall

Major and Minor Subject (areas of concentration are in parentheses) Operations Research (applied probability and statistics, industrial and systems engineering, mathematical programming)

In addition to choosing a major subject, a candidate selects one minor for the M.S. and two for the Ph.D. A minor may be in operations research or in a subject offered by another field of the Graduate School. Appropriate minor areas of concentration that have been chosen most frequently in recent years (listed with the departments or schools that offer these courses of study) are computer science (Computer Science), econometrics and economic statistics (Economics), environmental systems engineering (Civil and Environmental Engineering), managerial economics (Business and Public Administration), mathematics (Mathematics), and planning theory and systems analysis (City and Regional Planning).

Applicants must hold a bachelor's degree in engineering, mathematics, economics, or the physical sciences. All applicants are required to take at least the aptitude portion of the GREs. An appropriate GRE advanced test is also desirable, especially for applicants for financial aid.

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 at the end of the third term of graduate study at Cornell.

The field requires teaching experience of all graduate students.

The John McMullen Graduate Fellowship is specifically designated for incoming candidates in this field.

Professional Degree

The main objectives of the program leading to the professional degree of Master of Engineering (OR & IE) are to give each student greater breadth and depth of technical knowledge and to provide an environment in which he or she can synthesize the material studied in the course work. The emphasis is on mathematical modeling and on the application of quantitative techniques associated with optimization, probability, and statistics to the design and operation of systems.

Students are required to complete an engineering project in which they have the opportunity to work closely with practicing engineers or analysts as well as with Cornell faculty members. The projects are usually provided and sponsored by industrial or government organizations. Students are expected to perform all aspects of the project work, from problem formulation to communication of the results.

Subject Descriptions

Applied Probability and Statistics This area of study and research is appropriate for students whose primary interest is in the techniques and associated underlying theory of probability and statistics, particularly as applied to problems arising in science and engineering. The techniques emphasized are those associated with applied stochastic processes (e.g., queueing theory, traffic theory, and inventory theory) 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; and analysis of life data).

Those who elect to 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 have the equivalent of a minor in mathematics.

Industrial and Systems Engineering The analysis and design of complex operational systems are the central concerns in this area. Problems occurring throughout modern society are considered. These include manufacturing problems, such as the design of integrated production, the establishment of inventory and distribution systems, plant design, and economic analysis of engineering processes. Problems connected with government, banking, and public-service administration are also major subjects of study and research.

Students who specialize in this area are expected to have the ability to use modern analytical techniques in the design and analysis of systems; they need to acquire an understanding of inventory theory, scheduling theory, queuing theory, mathematical programming, computer science, and computer simulation. Research activity may involve the development of new methodology or the synthesis of existing knowledge.

Mathematical Programming Work in mathematical programming traditionally consists of linear, nonlinear, integer, and combinatorial programming (including network flows and scheduling theory). Research in these areas ranges from the development and application of computational algorithms (exact and approximate) to the associated studies of duality theory, convex analysis, fixed-point techniques, polyhedra, combinatorics, and graph theory. Another aspect is game theory—the general study of conflict and cooperation—which includes considerations of the properties of solutions and applications in economic market theory, bidding and auctions, cost-allocation schemes, and voting procedures.

Faculty and Specializations

R. E. Bechhofer: ranking and selection procedures; design of experiments; medical statistics
 L. J. Billera: game theory; combinatorics
 R. Bland: network flows; graph theory; mathematical programming
 E. B. Dynkin: probability theory; mathematical economics
 D. C. Heath: applied probability
 P. L. Jackson: stochastic models; finance
 W. R. Lynn: environmental systems
 W. L. Maxwell: scheduling; materials handling; simulation
 J. A. Muckstadt: inventory and logistics control
 G. L. Nemhauser: mathematical programming
 N. U. Prabhu: stochastic processes; queuing and storage theory
 R. O. Roundy: analytical management of production/inventory systems
 T. J. Santner: statistics
 L. W. Schruben: applied operations research; health systems
 F. L. Spitzer: probability theory
 M. S. Taqqu: applied probability and statistics
 H. M. Taylor III: applied probability
 M. J. Todd: mathematical programming
 L. E. Trotter, Jr.: mathematical programming
 B. Turnbull: biomedical statistics; quality control; reliability theory
 L. I. Weiss: statistical decision theory; nonparametric statistics

Peace Studies and Peace Science

Graduate Faculty Representative Walter Isard, B-4 Sibley Hall

Minor Subjects Peace Science, Peace Studies

Peace Studies and Peace Science are both interdisciplinary *minor* subjects that provide opportunity for graduate students to deepen their

knowledge of (a) international security, (b) the structure and function of multinational systems, and (c) the general area of conflict analysis, conflict management, and conflict resolution. The Peace Science minor emphasizes mathematical modeling and game-theoretic methods, while the Peace Studies minor emphasizes historical, institutional, and policy-oriented approaches. These minors are intended to complement basic study in such areas as government; economics; sociology; civil, environmental, and transportation engineering; operations research; city and regional planning; industrial and labor relations; psychology; and agricultural economics.

Faculty and Specializations

S. B. Caldwell: sociology and policy analysis
 W. Isard: economics and cooperative procedures
 J. V. Reppy: defense economics
 R. Rosecrance: government and international relations
 S. Saltzman: planning and information processing systems
 L. Scheinman: government and international organization and law
 R. E. Schuler: economics and environmental engineering
 H. Y. Wan, Jr.: economics and game theory
 R. M. Williams, Jr.: sociology and conflict analysis

Philosophy

Graduate Faculty Representative Gail Fine, 218 Goldwin Smith Hall

Major and Minor Subject Philosophy (for areas of concentration, see list of faculty and specializations below)

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 fifteen faculty engaged in full-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, but under exceptional circumstances the field has accepted M.A. students. It is recommended but not required that applicants to the program submit GRE aptitude test scores. In addition to other application materials required by the Graduate School, the *Field of Philosophy requires from every applicant a sample of his or her written work in philosophy*. 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. There are no field-wide course requirements. Each student's program of study is worked out individually in regular meetings each semester with his or her three-person Special Committee. There are no

written comprehensive examinations. The admission to candidacy examination is an oral examination on the student's thesis proposal and related subjects. The field requires teaching experience for all Ph.D. candidates.

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

Joint Program in Ancient Philosophy with the Field of Classics

The joint program aims at training productive scholars and effective teachers of ancient philosophy who will also be well-rounded classicists or philosophers. All students must demonstrate adequate basic knowledge of pre-Socratic philosophy, Plato, Aristotle, and ancient philosophy after Aristotle. Normally students applying to the program in the Department of Philosophy should know enough Greek to read philosophical texts; knowledge of Latin is not a requirement for admission for philosophy candidates. Further work in both languages will be expected. For further information write to one of the faculty members teaching ancient philosophy (listed below).

J.D. and Ph.D. (or M.A.) in Philosophy

This program is of special interest to students who want to concentrate in jurisprudence or legal philosophy. It enables students to coordinate their studies towards the J.D. degree and a graduate degree in philosophy, completing both degrees approximately a year sooner than would otherwise be possible. A student in the program may begin law study in the first year or after a year of course work in philosophy. Once law study is begun, it is continued until completion of the J.D. degree. Students who want to enter this joint program must make separate applications to the Law School and to the Field of Philosophy in the Graduate School. A student may apply to the program before matriculating in either law or philosophy and if admitted, may then decide in which discipline to spend the first year. Alternatively, a student may apply and be admitted to the program after having already begun the first year of study in either philosophy or law.

For further information write to the Department of Philosophy, 218 Goldwin Smith Hall.

Faculty and Specializations

- J. Bennett: social and political philosophy; aesthetics; philosophy of law; ethics
- R. Boyd: philosophy of science; philosophy of psychology; epistemology; philosophy of language; philosophy of mind
- G. Fine: ancient philosophy; the history of modern philosophy; epistemology and metaphysics
- C. Ginet: metaphysics; epistemology; philosophy of mind; philosophy of language; Wittgenstein; Descartes; Leibniz
- H. Hodes: logic; philosophy of language; philosophy of mathematics

- T. Irwin: ancient philosophy; moral and political philosophy; Kant
- N. Kretzmann: history of philosophy and logic; medieval philosophy; ancient philosophy; philosophy of religion
- D. B. Lyons: moral, political, and legal philosophy
- R. Miller: social and political philosophy; Marx; epistemology; aesthetics; philosophy of natural and social science; ethics
- P. Mitsis: ancient philosophy
- S. Shoemaker: metaphysics; philosophy of mind; history of modern philosophy; epistemology
- R. Stalnaker: philosophy of language; metaphysics; philosophy of logic
- N. Sturgeon: history of modern philosophy; ethics
- M. Wachsberg: ethics; philosophy of mind; political philosophy
- A. Wood: modern Continental philosophy; history of modern philosophy; social and political philosophy; philosophy of religion

Physics

Graduate Faculty Representative Tung-mow Yan, Newman Laboratory

Major and Minor Subject (areas of concentration are in parentheses) Physics (experimental physics, 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.

Although taking the GREs, including the advanced test in physics, is not formally required for admission, it is strongly recommended that this set of examinations be taken no later than December by prospective graduate students.

No foreign language is required either for admission or for a master's or a Ph.D., 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 Physics Graduate Admissions, 117 Clark Hall.

Research and Study Opportunities

Theoretical Physics Strongly interacting fermion systems; electronic properties of homogeneous and inhomogeneous systems; matter under extreme conditions; defects; classical and quantum liquids; superconductivity; statistical and phase transition; dynamical systems; turbulence; application of renormalization group to field theory and critical phenomena; phenomenology of heavy quarks; quantum chromodynamics; lattice gauge theories; computer simulation of relativistic quantum field theories; internal symmetries and their connection with strong interaction dynamics; quantum electrodynamics; unified strong, weak, and electromagnetic interactions; high-energy electromagnetic interactions; astrophysics; stellar structure and general relativity.

Experimental High-Energy Physics Students have the opportunity to study experimental elementary particle physics at CESR, the Cornell Electron Storage Ring, located on the Cornell campus. CESR is an electron-positron colliding beam facility that is uniquely suited for studies of the "b" quark in the Upsilon energy region. A sophisticated detector, CLEO, is being used to search for and to examine new particles composed of heavy quarks and to study the energy levels and decays of the Upsilon particles. Presently a major upgrade of the CLEO detector is under way. Graduate students working in this program have an excellent opportunity to learn the art of experimental elementary particle physics research while taking part in work at a very basic and exciting frontier of the field.

The program of storage ring development provides a unique opportunity for graduate students interested in accelerator physics. In addition, there is an active program to develop the superconducting radio-frequency cavities that will be needed for the next generation of electron-positron storage rings.

Cornell is a member of University Research Associates, which operates the Fermi National Accelerator Laboratory, at Batavia, Illinois, where a 500-GeV proton synchrotron is in operation and 2 TeV proton-antiproton collider will soon be commissioned. A group of Cornell physicists is participating in the first experiment to measure proton-antiproton scattering in the collider. This experiment will continue to provide opportunities for graduate students who work at Fermilab.

Experimental Condensed Matter Physics Liquid and solid ^3He and ^4He (particularly superfluid phases); spin-polarized hydrogen; near and far infrared studies of surfaces, solids and heterogeneous media; laser spectroscopy; submicron physics; spin resonance in metals and semiconductors; properties of amorphous and highly disordered crystalline solids; thin films and interfaces; time-resolved studies of surface phenomena; atom and ion scattering from solid surfaces; boundary effects of phase transitions in liquid mixtures; metal-insulator transitions; atomic diffusion in metals and insulators; inelastic X-ray scattering from atoms and solids.

Faculty

V. Ambegaokar, N. W. Ashcroft, K. Berkelman, D. G. Cassel, G. V. Chester, B. H. Cooper, R. M. Cotts, J. W. DeWire, M. Feigenbaum, M. E. Fisher, D. B. Fitchen, C. P. Franck, R. S. Galik, M. G. Gilchriese, B. Gittelman, K. Gottfried, S. Gregory, K. I. Greisen, L. N. Hand, D. L. Hartill, W. Ho, D. F. Holcomb, H. Kawai, T. Kinoshita, J. A. Krumhansl, D. M. Lee, P. Lepage, R. M. Littauer, B. D. McDaniel, N. D. Mermin, N. B. Mistry, J. Orear, R. O. Pohl, J. D. Reppy, R. C. Richardson, E. E. Salpeter, J. Sethna, S. Shapiro, R. H. Siemann, A. J. Sievers, E. D. Siggia, R. H. Silsbee, A. Silverman, P. C. Stein, R. M. Talman, S. A. Teukolsky, M. Tigner, W. W. Webb, J. W. Wilkins, K. G. Wilson, T.-M. Yan, D. R. Yennie

Closely associated with the graduate program in physics are a number of faculty in related fields who teach 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 often work informally.

Physiology

(See also the listing under Medical Sciences.)

Graduate Faculty Representative Daniel Tapper, 724 Vet. Research Tower

Major and Minor Subject (areas of concentration are in parentheses) Physiology (behavioral physiology, cellular physiology, comparative physiology, endocrinology, gastrointestinal and metabolic physiology, neurophysiology, reproductive physiology, vertebrate physiology)

See also the list of faculty and specializations below 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 GRE aptitude test and advanced test in biology. Applicants should have obtained a good knowledge of biology, chemistry, biochemistry, and physics. Calculus, statistics, and genetics are also advisable.

The field requires that the candidate form his or her Special Committee with field-appointed members by the end of the second semester. At this time, or at some time before the end of the second semester, the entire committee meets to discuss and formulate the specific academic program of the candidate. It is also required by the field that each candidate teach for two semesters.

The field has instituted specific course requirements for graduate students in order to provide basic information and breadth in the physiological sciences. The student's Special Committee and/or the Field Directory should be consulted regarding these requirements.

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 whose interests are nearest their own.

Behavioral physiology: E. Adkins Regan, K. A. Houpt, T. R. Houpt

Biochemistry of connective tissue: G. Lust

Developmental immunology: J. A. Marsh

Cellular physiology: R. A. Corradino, A. Quaroni,

G. W. G. Sharp, R. H. Wasserman, J. F. Wootton

Comparative and environmental physiology:

K. W. Beyenbach, W. N. McFarland, F. H. Pough

Endocrinology: E. Adkins Regan, W. R. Butler,

R. A. Corradino, W. B. Currie, R. H. Foote,

J. E. Fortune, H. H. Hagedorn, W. Hansel,

J. A. Marsh, P. W. Nathanielsz, T. J. Reimers,

G. W. G. Sharp, A. van Tienhoven

Enzymology: J. F. Wootton

Gastrointestinal physiology: A. Bensadoun,

R. A. Corradino, A. Dobson, T. R. Houpt,

G. W. G. Sharp, R. H. Wasserman

Herpetology: F. H. Pough

Invertebrate physiology: H. H. Hagedorn

Lactation: R. C. Gorewit, F. W. Lengemann

Lipid transport and metabolism: A. Bensadoun

Metabolism: E. N. Bergman, T. R. Houpt,

F. W. Lengemann, H. F. Schryver

Neurophysiology: E. L. Gasteiger, B. Halpern,

E. R. Loew, D. N. Tapper, A. van Tienhoven

Pathological physiology: G. Lust, H. F. Schryver

Renal physiology: K. W. Beyenbach

Reproduction: E. Adkins Regan, W. R. Butler,

A. P. Casarett, W. B. Currie, R. H. Foote,

J. E. Fortune, H. H. Hagedorn, W. Hansel, P. W.

Nathanielsz, T. Reimers, A. van Tienhoven

Ruminant physiology: E. N. Bergman, A. Dobson,

A. F. Sellers

Sensory physiology: E. L. Gasteiger, K. A. Houpt, H. C.

Howland, E. R. Loew, W. N. McFarland, D. N. Tapper

Vertebrate physiology: T. R. Houpt, H. C. Howland

plant breeding or plant genetics as an area of concentration. Research may involve studies of breeding methods, application of genetic principles to breeding, and correlation of knowledge from other areas, such as physiology, biochemistry, and statistics, in attacks on problems of yield, quality, adaptability, and disease-insect resistance. Students may also select research problems involving cell and tissue culture or molecular genetics. Plant genetics generally involves research more specifically aimed toward the analysis of hereditary and evolutionary phenomena.

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 made for students interested in international or extension experience.

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. Plant breeding staff direct thesis research on the crop plants with which they are primarily concerned.

R. E. Anderson: golden nematode resistance in potatoes

W. R. Coffman: plant breeding; international agriculture

E. D. Earle: tissue and cell culture

V. E. Gracen: genetics and biochemistry of insect and disease resistance

P. Gregory: biochemistry of plant breeding

M. A. Mutschler: vegetable crops

W. D. Pardee: extension and seed production

R. L. Plaisted: potatoes

M. E. Sorrells: small grains

S. D. Tanksley: molecular genetics of crop plants

D. R. Viands: forage crops

D. H. Wallace: vegetable crops

R. W. Zobel: crop ecology; crop physiology

At the New York State Agricultural Experiment Station in Geneva

M. H. Dickson: vegetable breeding

R. C. Lamb: fruit breeding

G. A. Marx: vegetable breeding

B. I. Reisch: grape breeding

R. W. Robinson: vegetable breeding

J. C. Sanford: small fruit breeding

N. Weeden: genetics and biochemistry of crop species

Plant Breeding

Graduate Faculty Representative Mark Sorrells, 420 Bradfield Hall

Major and Minor Subject (areas of concentration are in parentheses) Plant Breeding (plant breeding, 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, and calculus. It is strongly recommended that applicants submit GRE results.

Students interested in crop improvement through breeding and the genetics of higher plants may choose

Plant Pathology

Graduate Faculty Representative Steven V. Beer, 410 Plant Science Building

Major and Minor Subject (areas of concentration are in parentheses) Plant Pathology (molecular plant pathology, mycology, plant pathology)

Admission

Applicants should have introductory-level knowledge of biochemistry, botany, calculus, chemistry, genetics, microbiology, mycology, organic chemistry, physics,

plant pathology, plant physiology, soil science, statistics, and computers. A deficiency in any of those subjects will not preclude admission, but it will likely increase the time needed to complete a graduate degree program. Course work or experience in plant pathology is desirable but is not required.

Applicants from the United States must present scores from the GRE aptitude test. Successful applicants usually achieve combined verbal-quantitative scores of at least 1,200. Scores from the biology advanced test are strongly encouraged. Applicants from other countries are encouraged, but not required, to present scores from the same tests. Early application is strongly encouraged, especially if fellowship or assistantship support is requested.

Program and Facilities

Excellent opportunities for study and research are offered for the M.S., the M.P.S., and the Ph.D. degrees. Summer field trips with staff members give students an appreciation of agriculture and the importance of plant diseases and the opportunity to observe applied research and extension programs. Students are required to obtain teaching experience in plant pathology by assisting in courses and by presenting both formal and informal seminars on their research. Students majoring in plant pathology may specialize in a particular branch of plant pathology, such as disease cytology, disease management, epidemiology, molecular plant pathology, physiology, phyto bacteriology, phytonematology, phytovirology, soilborne pathogens, or tropical plant pathology, or in a crop-oriented area, such as diseases of field crops, forage, fruits, ornamentals, potatoes, shade trees and shrubs, turfgrasses, or vegetables. Students electing a major in mycology may develop research programs in cytology, genetics, morphology, molecular biology, physiology, or taxonomy of fungi.

Students majoring in plant pathology or mycology take oral or written qualifying examinations within six months after their first registration, in addition to the examinations required by the Graduate School.

Cornell University has two departments of plant pathology. All courses are given in the Ithaca department, and most students conduct their research there. The department at Geneva (fifty miles from Ithaca) emphasizes basic and applied research on diseases of fruits and vegetables and provides opportunities (including some assistantships) for students to conduct research. An outstanding mycological and plant pathological herbarium, superior library facilities, and modern laboratory equipment are available at Ithaca. Excellent laboratories with modern equipment, library, greenhouse, and field facilities are available at Geneva. Provisions can be made for students to carry out research at outlying field stations and in special circumstances in other countries.

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—soilborne pathogens; plant-disease control; root diseases of vegetables
- J. R. Aist: research—disease and fungal cytology
- H. S. Aldwinckle: * administration; research—breeding; genetics; disease resistance of fruits
- P. A. Arneson: teaching—plant protection; research—epidemiology; computer simulation modeling
- S. V. Beer: research—bacterial diseases; disease physiology and molecular plant pathology
- G. C. Bergstrom: extension and research—diseases of field crops, integrated pest management
- B. B. Brodie: research—nematology; biology; ecology; pest management; breeding for resistance
- T. J. Burr: * research and extension—fruit diseases caused by fungi and bacteria
- R. S. Dickey: research and teaching—phytopathogenic bacteria
- H. R. Dillard: * extension and research—diseases of vegetables
- W. E. Fry: administration; research—plant disease epidemiology and control
- D. Gonsalves: * research—virus diseases of fruits and vegetables; biological control of virus diseases
- G. F. Harman: * administration; research—seed pathology; physiology of parasitism; resistance mechanisms; biological control
- M. B. Harrison: research and teaching—nematology; diseases caused by nematodes on forage, turf, nursery, and vegetable crops
- H. C. Hoch: * research—cell biology of fungi, especially host recognition and infection structure development; biological control of vegetable diseases
- R. K. Horst: research and extension—diseases of florist and ornamental crops
- G. W. Hudler: research, teaching, and extension—diseases of woody ornamentals
- J. E. Hunter: * research—fungal and bacterial diseases of vegetables; integrated pest management
- H. W. Israel: research and teaching—cytology of pathogens and diseased plants
- E. D. Jones: extension and research—diseases of potatoes; potato certification; foundation seed programs
- R. P. Korf: teaching and research—mycology; taxonomy, morphology, biology, and phytogeography of fungi
- J. W. Lorbeer: research—diseases of vegetables; soilborne pathogens; fungal genetics; epidemiology; teaching—mycology
- R. Loria: research and extension—diseases of vegetables; integrated pest management
- R. L. Millar: research—physiology of infection; ecology; diseases of forage crops
- P. E. Nelson (adjunct professor, located at Pennsylvania State University): research—disease of ornamental crops; pathological histology; biology and taxonomy of *Fusarium*
- P. Palukaitis: research—molecular plant pathology; virus diseases
- R. C. Pearson: * research—epidemiology and control of grape diseases
- R. Providenti: * research—virus diseases of vegetables; genetics of resistance

- W. F. Rochow: research—virus diseases of cereal crops; aphid transmission of plant viruses
- D. A. Rosenberger: * research and extension—epidemiology and control of fruit diseases
- R. C. Seem: * research—quantitative epidemiology of fruit and vegetable diseases; pathosystem analysis and modeling
- W. A. Sinclair: teaching—plant pathology; research—dendropathology
- R. W. Smiley: research and extension—turfgrass diseases; root diseases of small grains and turfgrasses
- R. C. Staples (adjunct professor, located at the Boyce Thompson Institute): research—biology of fungal spore germination and infection structure development
- H. D. Thurston: teaching and research—potato diseases; breeding for disease resistance; tropical plant diseases and their control
- H. D. VanEtt: research and teaching—fungal diseases and pathogen physiology; molecular plant pathology
- W. F. Wilcox: * extension and research—diseases of fruit; soilborne pathogens of fruit
- O. C. Yoder: research and teaching—molecular biology and genetics of fungal plant pathogens; molecular plant pathology
- M. Zaitlin: research—plant virus replication; molecular biology of virus disease; teaching—plant virology; administration—biotechnology
- T. A. Zitter: extension and research—diseases of vegetable crops; virus diseases of vegetables

*Cornell faculty located at the New York State Agricultural Experiment Station at Geneva.

Plant Protection

Graduate Faculty Representative Phil A. Arneson, 412 Plant Science Building

Major and Minor Subject Plant Protection

Plant protection is a major field for the M.P.S. (Agriculture) degree only. Admission to the field is based on a strong background in the basic biological and physical sciences and substantial preparation in agricultural and plant protection subjects. Applications are encouraged from agricultural graduates who have been working for several years and now want to pursue an advanced degree, as well as from students just completing a bachelor's degree.

The field requires a minimum of 30 credits (of which 24 must be for courses numbered 400 or above) plus an approved internship consisting of one growing-season's experience in an extension pest management program. The internship requirement may be waived for candidates already having appropriate experience. A problem-solving project is also required, a report of which must be submitted to the M.P.S. (Agriculture) Committee. Upon completion of the above requirements each candidate must take a final examination, which may be written, oral, or a combination of both, at the discretion of the Special Committee.

The suggested course of study stresses statistics and farm business management and develops depth in ecology, entomology, plant pathology, and weed science. The program is sufficiently flexible to accommodate the varying career objectives of the students as well as a wide range of crop interests.

Faculty and Specializations

- P. A. Arneson: plant pathology
W. B. Duke: agronomy
C. J. Eckenrode: * entomology
W. E. Fry: plant pathology
A. J. Sawyer: entomology
R. C. Seem: * plant pathology
W. A. Sinclair: plant pathology
G. B. White: agricultural economics

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

Pomology

Graduate Faculty Representative F. W. Liu, 125 Plant Science Building

Major and Minor Subject Pomology

Applicants to this field should have a sound background in the basic sciences and an interest in fruit plants but need not have done their undergraduate work in horticulture. A knowledge of botanical and chemical subjects is necessary. Scores from the GRE are required. 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. 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 (Pomology and Viticulture) 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 cold hardiness, fruit breeding, fruit set and development, general cultural practices, growth-regulating substances, mineral nutrition, photosynthesis, plant pigments, plant—water relations, postharvest physiology and storage, rest period, root initiation, and rootstocks. 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: postharvest physiology
L. L. Creasy: physiology and biochemistry of plant phenolics
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

M. P. Pritts: cultural practices and physiology with small-fruit crops

W. C. Stiles: soil management; cultural practices

At Geneva

J. N. Cummins: resistant rootstock breeding, genetics and testing; high-density systems; rooting studies; virus interactions

C. G. Forshey: mineral nutrition; growth regulators; fruit tree physiology

A. N. Lakso: orchard management; mechanical harvesting; environmental physiology

R. C. Lamb: breeding for disease resistance in apples and pears and for cold resistance in peaches and apricots

R. M. Pool: general viticulture; vine physiology

B. I. Reich: grape breeding; genetics

T. L. Robinson: tree fruit culture

J. C. Sanford: small-fruit breeding; small-fruit culture; genetics

Psychology

Graduate Faculty Representative James Cutting,
220 Uris Hall

Major and Minor Subject (areas of concentration are in parentheses) Psychology (biopsychology, human experimental psychology, personality and social psychology, general psychology)

In addition to transcripts of their undergraduate record, two or three letters of recommendation, and a personal statement of interests, applicants must submit scores on the GRE aptitude test. The GRE advanced test in psychology and an undergraduate major in psychology are desirable but not required. Prior research experience is particularly desirable. Applicants may submit research reports or other specimens of their work if they wish. Candidates for a terminal master's degree are not accepted. The normal closing date for applications is January 15. Persons whose primary interests lie in clinical, counseling, industrial, or school psychology should not apply.

Each student develops an independent program of study in consultation with his or her Special Committee. The three primary members of the Special Committee must be chosen by the end of the first year; students are encouraged to select at least one member (not the chairperson) from a field other than psychology. The graduate faculty representative will appoint a fourth member, whose function is to ensure that the student obtains adequate breadth of training.

Certain requirements are established by the field, acting through an elected executive committee consisting of both faculty and students. These requirements are usually enforced by the Special Committees, although it is the Special Committee and not the field that has final authority over each student's course of study. The present requirements include (1) a first-year review and annual meetings of the Special Committee to review the student's progress; (2) a research paper completed by the end of the first year, and an oral report of the research made to a meeting of students and faculty; (3) a one-year course in statistics and experimental design; (4) at least ten hours a week of supervised teaching experience for at least two

semesters; (5) the examination for admission to candidacy, which should be taken by the end of the third year (a Graduate School requirement); (6) a written dissertation proposal, which must be accepted at a meeting of the Special Committee called for that purpose; (7) the doctoral dissertation itself, and a final examination on the dissertation (Graduate School requirements).

Financial support for students is available in the form of teaching assistantships, research assistantships, predoctoral traineeships, and fellowships. The John Wallace Dallenbach Fellowship in Experimental Psychology is intended specifically for students in the Field of Psychology.

Research facilities include special rooms for research in problems of perception and cognition; a social psychology laboratory equipped for experimental and observational studies of transitory and enduring groups; electrophysiological, histological, and chemical laboratories; surgery facilities; facilities for the maintenance and behavioral study of vertebrate and invertebrate laboratory animals; darkrooms and shops; an audiovisual studio equipped for the study of teaching; facilities for research with a variety of laboratory animals; laboratory computers and interacting terminals with the capacity to control equipment in experiments, to do on-line processing, and complex data analyses; a mobile laboratory for the study of children near their schools; and other specialized facilities, both on campus and at various off-campus locations.

The Field of Psychology cooperates with other fields in various interdisciplinary programs. The Fields of Psychology, Neurobiology and Behavior, Nutrition, and Physiology maintain close ties, and collaborative research with members of those fields is encouraged. The Field of Psychology also maintains close ties with the Fields of Sociology and of Human Development and Family Studies.

Faculty and Specializations

Biopsychology (animal behavior, neuropsychology, physiology, and behavior): E. Adkins-Regan, T. deVoogd, B. Finlay, B. P. Halpern, H. C. Howland, R. E. Johnston, D. A. Levitsky

Human experimental psychology (perception, cognition, psycholinguistics, development): U. Bronfenbrenner, J. E. Cutting, J. Freyd, F. Keil, B. Koslowski, C. L. Krumhansl, L. C. Lee, H. Levin, B. Lust, M. Potts, H. Ricciuti, R. E. Ripple, G. J. Suci
Personality, social psychology: D. Bem, S. Bem, U. Bronfenbrenner, J. Condry, W. Cross, L. Fitzgerald, T. D. Gilovich, L. W. Gruenfeld, T. Hammer, J. S. Harding, D. P. Hayes, W. W. Lambert, I. Lazar, R. D. Mack, D. Regan, B. C. Rosen, E. Walker, L. K. Williams

Differential psychology, quantitative and mathematical psychology: R. Darlington, J. Millman

General psychology, history of psychology: H. Levin, J. Maas

Psychopathology: J. Doris, D. Hedlund, R. D. Mack

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 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

D. J. Allee, J. A. V. Allen, R. Battistella, F. T. Bent, F. Buttel, L. D. Chapman, P. Clavel, S. Clemhout, T. E. Davis, A. T. Dotson, P. R. Eberts, E. C. Erickson, M. J. Esman, E. S. Flash, Jr., J. L. Ford, J. Forester, W. W. Goldsmith, D. J. Greenwood, A. J. Hahn, S. Jasanoff, B. G. Jones, R. J. Kalter, E. W. Kelley, I. Lazar, D. B. Lewis, R. C. Lind, D. P. Loucks, T. J. Lowi, W. R. Lynn, A. K. McAdams, E. Maynes, B. J. Mueller, D. W. Nelkin, N. Orloff, T. J. Pempel, R. Rosecrance, S. Saltzman, R. E. Schuler, S. W. Stein, R. S. Summers, N. T. Uphoff, J. Vanek, J. M. Ziegler

Regional Science

Graduate Faculty Representative Stan Czamanski,
108 West Sibley Hall

Major and Minor Subject (areas of concentration are in parentheses) Regional Science (environmental and energy systems, international spatial problems, location theory, multiregional economic analysis, peace science, planning methods, transportation, urban and regional economics)

The Ph.D. program is designed to provide the student with (1) a thorough understanding of regional, interregional, and location and conflict theory within the context of physical and policy spaces and the framework of existing economic, social, and political systems; and (2) a mastery of techniques of analysis of urban-regional systems as they relate to public and private decision making. Heavy emphasis is placed upon mathematical models and quantitative methods. The student is fully exposed to the existing and newly developing social science theory that 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 and conflict 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.

Students may ask any member of the Graduate Faculty to serve on their Special Committee. The chairperson must be a member of the graduate Field of Regional Science.

The primary objective of the postdoctoral program is to deepen the understanding of complex urban, regional, spatial, and conflict phenomena by (1) bringing together within the regional science groups 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 and peace science seminars held once or twice a week. It is expected that each postdoctoral scholar will undertake research of high quality that will lead to publication in scholarly journals such as the *Journal of Regional Science* and *Conflict Management and Peace Science*.

Faculty and Specializations

D. J. Allee: resource economics; regional economics; regional development planning
R. Boisvert: economic development; employment, income distribution
S. Czamanski: regional industrial development; industrial complex analysis; optimization and econometric techniques in planning
G. P. Fisher: urban transportation planning; public transportation; operations analysis; human factors in transportation
W. W. Goldsmith: political economy; international urbanization; development and underdevelopment
W. Isard: location theory; conflict management procedures; peace science; general social science theory and methods; environmental management
B. G. Jones: urban and regional theory; quantitative analysis; urbanization theory; planning theory; environmental health planning
R. J. Kalter: economic evaluation of public investment; water projects; recreation; environmental quality; energy
D. B. Lewis: international development; science and technology policy in developing nations; quantitative methods for policy evaluation
D. P. Loucks: mathematical modeling of water resources and environmental quality management systems; urban noise control; regional development; multi-objective evaluation methods; interactive computer graphics

- W. F. Lucas: game theory; combinatorics; mathematical modeling
- W. R. Lynn: environmental systems; planning and public policy issues
- A. H. Meyburg: urban transportation planning; travel demand modeling; urban goods movement; transportation-communications relationships; transit systems operations
- S. Saltzman: quantitative analysis; regional modeling; public policy research; processing systems
- R. E. Schuler: urban and spatial economics; public economics; utility regulation
- E. Thorbecke: development planning; theory of quantitative economic policy; international trade
- H. Y. Wan, Jr.: dynamic economic models, international trade; resource economics
- R. M. Williams, Jr.: peace science; social development; conflict analysis

Romance Studies

Graduate Faculty Representative Mary G. Randel,
263 Goldwin Smith Hall

Major and Minor Subject (areas of concentration are in parentheses) Romance Studies (French linguistics, French literature, Italian linguistics, Italian literature, Romance linguistics, Spanish linguistics, Spanish literature)

The Field of Romance Studies includes faculty from three departments (Romance Studies, Comparative Literature, Modern Languages and Linguistics) and offers a diverse, interdisciplinary program of research and instruction in the Romance languages and literatures. Language courses in French, Italian, Portuguese, Romanian, and Spanish are given in the broad cultural and linguistic setting of a department providing instruction in general and applied linguistics, as well as in some thirty-five major languages and regional tongues. Romance studies seeks to maintain and transmit the traditional philological discipline, and to that end offers a full complement of courses in French, Italian, and Hispanic literatures. It seeks also to incorporate the speculative, theoretical view of literature current in Europe today and reflected in the review *Diacritics*, which since 1971 has been edited and published by members of the field.

Students within the Field of Romance Studies may choose to work in either of two major subfields: Romance linguistics or Romance literature. Many students of Romance studies take some courses in both literature and linguistics. Appropriate minors may be drawn from such diverse areas as Afro-American studies, anthropology, applied linguistics, classics, comparative literature, English language and literature, general linguistics, Germanic studies, history, history of art, history of science, Latin American studies, medieval studies, musicology, Near Eastern studies, Old Icelandic literature, philosophy, psycholinguistics, Romance linguistics, Slavic studies, sociology, theatre arts (including cinema and dance), and women's studies.

In practice, most graduate students in Romance literature now elect only one minor area of concentration; in Romance linguistics, two, one or both

of which usually lie within the Field of Romance Studies (such as French or Spanish literature) or the Field of Linguistics (such as applied linguistics or general linguistics).

In Romance linguistics, the student 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 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 area of concentration either the linguistics (descriptive and historical) of a specific Romance language or the comparative study of the Romance languages.

Normally one of the minor areas will be the literature of the language in which the student's major interest lies.

For the M.A. in the concentration of 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.

In Romance literature, students choose one national literature as their major concentration. They are expected to acquire a basic working knowledge of the general history of that literature, along with the history of the national language, and to become conversant with social and intellectual history. They are expected to speak and write their major language fluently and correctly. They are trained in those bibliographical, linguistic, and analytical skills basic to teaching and research in the interpretation of literature.

In the concentration of Romance literature, a student is not required to have a reading knowledge of one or more foreign languages other than the language of the major concentration unless linguistic competence of this type is necessary to his or her research. The need for such competence is determined by the student's Special Committee.

A certain number of graduate students in Romance studies each year obtain support from fellowships available in the Graduate School. Relatively large undergraduate enrollments in French, Italian, and Spanish courses (both in language and literature) require the employment of numerous teaching assistants. Every attempt is made to provide new teachers with careful guidance and support. A special summer course on the teaching of language allows beginning assistants to observe and participate in the classroom teaching of French or Spanish and to attend lectures and discussions on theory and practice.

The field does not have a formal program for study in Europe, but students are encouraged to spend a term or a year abroad whenever study in another country seems appropriate—either for improvement of language skills or for the advancement of their

research. Close ties of professional acquaintance make it possible for students in French or Italian to attend seminars at such institutions as the Ecole Normale Supérieure and the Ecole Pratique des Hautes Etudes in Paris or the University of Bologna. Students in Spanish often conduct thesis research in archives or libraries in such cities as Madrid, Seville, Mexico City, and Lima. A special endowment allows the Department of Romance Studies to provide some of its students with small subsidies for study abroad.

Applicants are strongly urged to include scores of the aptitude and advanced tests of the GREs with their other credentials and are urged to take those examinations by mid-December.

For course offerings, please see the catalog *Courses of Study* under the headings "Comparative Literature" and "Modern Languages, Literatures, and Linguistics."

Faculty and Specializations

- C. M. Arroyo: Spanish intellectual history; medieval and modern Spanish literature; philosophy
 J. Béraud: stylistics; French civilization
 J. Culler: literary theory; nineteenth- and twentieth-century French literature
 N. Furman: nineteenth-century French literature; feminist criticism
 A. Grossvogel: nineteenth- and twentieth-century Italian literature
 D. I. Grossvogel: twentieth-century French literature; literature and cinema
 W. W. Holdheim: history of ideas; contemporary French literature
 W. J. Kennedy: French and Italian Renaissance literature
 R. J. Klein: nineteenth- and twentieth-century French literature; literary criticism
 J. W. Kronik: nineteenth- and twentieth-century Spanish literature; Spanish-American theater
 P. E. Lewis: seventeenth- and nineteenth-century French literature; literary criticism
 E. P. Morris: sixteenth-century French literature; literature and the visual arts; literary history and musicology
 J. S. Noblitt: French linguistics; applied linguistics; Old Provençal
 M. Randel: Spanish literature of the Golden Age
 C. Rosen: Italian linguistics; comparative Romance linguistics
 E. M. Santi: Hispanic American literature
 A. Seznec: seventeenth- and eighteenth-century French literature
 M. Suñer: Spanish linguistics
 J. Tittler: contemporary Spanish-American novel
 K. Vernon: modern Hispanic literature; comparative literature
 L. Waugh: French linguistics; general linguistics; semiotics

Slavic Studies

Graduate Faculty Representative E. Wayles Browne, 308 Morrill Hall

Major and Minor Subject (areas of concentration are in parentheses) Slavic Studies (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 areas of concentration. A student who chooses either Russian literature or Slavic linguistics as a major may choose the other for a minor or may choose minor areas of concentration from other fields in the University, such as other literatures, linguistics, history, art, government, economics, psychology, mathematics, computer science, philosophy, and music. A Ph.D. candidate will normally have two minor areas of concentration, 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 toward 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. 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. are normally required to spend two semesters as teaching apprentices as a part of their training toward the degree.

Faculty and Specializations

- L. Babby: Slavic linguistics; history and structure of Russian; syntactic theory; Turkish
 W. Browne: Slavic linguistics; Balkan languages; linguistic theory; language pedagogy
 P. Carden: nineteenth- and twentieth-century prose; modernism and the avant-garde; critical theory
 C. Emerson: nineteenth- and twentieth-century Russian literature; Bakhtin and the later Formalists; Russian vocal music
 G. Gibian: nineteenth-century prose; 1920s; contemporary literature
 R. Leed: historical Slavic linguistics; language pedagogy
 S. Senderovich: Old Russian literature; eighteenth- and nineteenth-century literature; structural and phenomenological poetics

Sociology

Graduate Faculty Representative Michael T. Hannan, 323 Uris Hall

Major and Minor Subject (areas of concentration are in parentheses) Sociology (policy analysis, population studies, research methods, social organization and change, social psychology)

All inquiries about the graduate program in sociology should be made directly to the graduate faculty representative. Applicants from the United States and Canada are required to submit GRE aptitude scores.

M.A. candidates major in general sociology, which covers the four specific subjects of population studies, research methods, social organization and change, and social psychology.

Students in the Ph.D. program may register in general sociology initially but must select one of the five major areas of concentration before taking the admission to candidacy examination. Two minors are also chosen, either within sociology or from related fields.

All students in the Ph.D. program are required to have one year of directed teaching experience at Cornell unless specifically exempted. 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 bachelor's degree. A written plus oral admission to candidacy examination is usually taken early in the third year, followed by the dissertation and oral defense. A diagnostic qualifying examination may be held at an earlier point if requested by either the student or the Special Committee. All examinations are individually designed by the committee to match the particular interests of the student. Additional details are available in pamphlets issued by the graduate faculty representative.

Concentration Descriptions

Policy Analysis This major requires (1) a thorough knowledge of both experimental and nonexperimental research designs and analytic techniques as used in applied settings; (2) a working knowledge of the policy research literature; (3) a detailed knowledge of some specialized aspect of policy research.

Population Studies 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 Methods This major requires (1) a detailed knowledge of the logic of science; (2) a general knowledge of research design, data collection techniques, and analytical 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 and research in social organization and change; (2) a working knowledge of research methods; (3) a detailed knowledge of one or 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.

Research Opportunities

The Cornell Institute for Social and Economic Research (CISER), founded in May 1981, currently includes several hundred social science faculty members from twenty-seven academic departments at Cornell. CISER's mandate is to strengthen the links among basic social science research, public policy, and public service applications.

Many faculty members in the field conduct research in cross-national settings: Africa, Asia, Europe, and Latin America. Staff members participate in the International Population Program (IPP) and in area study programs affiliated with the Center for International Studies.

The IPP and CISER provide opportunities for involving Cornell graduate students in all phases of the research process.

Faculty and Specializations

Policy analysis: S. Bacharach, F. H. Buttel, S. Caldwell, P. R. Eberts, R. McGinnis, P. Moen, D. Nelkin, R. N. Stern, J. M. Stycos, H. Trice, W. F. Whyte (emeritus), R. M. Williams, Jr.
Population studies: R. C. Avery, P. Chi, B. Edmonston, C. Hirschman, J. M. Stycos, J. J. Zuiches
Research methods: R. L. Breiger, S. Caldwell, B. Edmonston, M. Hannan, D. P. Hayes, R. McGinnis
Social organization and change: M. Y. Abolafia, R. L. Breiger, F. H. Buttel, P. R. Eberts, M. Hannan, C. Hirschman, E. L. Kain, P. Moen, V. Nee, S. Olzak, B. Rubin, A. P. Shlay, R. N. Stern, P. S. Tolbert, R. M. Williams, Jr., J. J. Zuiches
Social psychology: D. Bem, S. Bem, D. P. Hayes, W. W. Lambert, L. Meltzer, B. C. Rosen

Statistics

Graduate Faculty Representative L. D. Brown, 227 White Hall

Major and Minor Subject (areas of concentration are in parentheses)

Statistics (biometry, decision theory, economic and social statistics, engineering statistics, experimental design, mathematical statistics, probability, sampling, statistical computing, stochastic processes)

Applicants must have evidence in their bachelor's and/or master's transcript of strength in the mathematical sciences, and they must demonstrate strong motivation for advanced study in statistics. Applicants are urged to present scores from the GRE aptitude test.

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

Each Ph.D. candidate shall have either one or two minor areas of concentration and shall, before the Ph.D. dissertation oral exam, demonstrate to the chairperson of his or her Special Committee a level of proficiency in one of the following languages: French, German, Russian, Chinese, Japanese, or Spanish.

Faculty and Specializations

- R. E. Bechhofer: design of experiments; selection and ranking
 T. Berger: information theory; detection and estimation
 I. Blumen: nonparametrics; multivariate analysis
 L. D. Brown: statistical decision theory; sequential analysis
 G. Casella: decision theory; regression
 E. B. Dynkin: stochastic processes
 R. H. Farrell: decision theory; multivariate analysis
 W. T. Federer: statistical design; estimation and analysis
 T. L. Fine: foundations of probability; statistical signal processing
 A. Hadi: regression diagnostics
 D. C. Heath: applied probability; finitely additive probability
 J. Hwang: estimation; decision theory
 H. Kesten: limit laws; random walks
 N. Kiefer: econometrics; Bayesian analysis
 P. J. McCarthy: sample survey theory; sample survey practice
 C. E. McCulloch: linear models; ecological statistics
 D. S. Robson: biological statistics; sampling theory
 T. J. Santner: applied statistics; selection and ranking
 S. J. Schwager: multivariate analysis; data analysis
 S. R. Searle: linear models; variance components
 F. L. Spitzer: probability theory
 L. Stefanski: robust statistics; errors in variables
 M. S. Taqqu: applied probability; time series
 H. M. Taylor: applied probability
 B. W. Turnbull: biomedical statistics; reliability and life testing
 P. F. Velleman: statistical computing; robust exploratory methods
 L. Weiss: nonparametric statistics; large sample theory

Textiles

Graduate Faculty Representative S. Kay Obendorf, 253 Martha Van Rensselaer Hall

Major and Minor Subject (areas of concentration are in parentheses) Textiles (textiles, clothing, apparel design); Textile Science (fiber science, polymer science, textile science)

The field offers graduate study leading to the M.A., M.S., or Master of Professional Studies (Human Ecology) degree. The common focus of the field is on problems involving textiles, apparel, and fibrous structures.

Within the concentrations in the major, a student may specialize in (1) textile science, (2) apparel and textile economics and marketing, or (3) functional apparel design. Students in the major are expected to develop strength within the base discipline, as well as breadth in the appropriate areas that support the area of specialization. Active research programs exist in international trade in textiles and apparel, marketing, high-performance fibers and fiber-reinforced composites, textile materials in biomedical applications, detergency and surface chemistry, polymers for electronics, textile dye chemistry, functional apparel design, and standards development.

Admission is based upon evidence of potential for advanced study. The Field of Textiles requires all applicants to take the aptitude portion of the Graduate Record Examinations. Applicants to the Field of Textiles who want to specialize in functional apparel design must submit a portfolio as part of their application materials. The portfolio should be sent to the graduate faculty representative.

About two-thirds of the graduate students in the field hold teaching or research assistantships. General fellowships, as well as two fellowships specifically designated for students in the Field of Textiles, are available.

Resources for Research

Laboratory resources include textile and polymer science laboratories with modern instrumentation for chemical, physical, and mechanical analysis; complete microscopy facilities, including an ISI Super III scanning electron microscope; a controlled-temperature and humidity room; and well-equipped apparel design laboratories. Cornell University's extensive costume collection provides an additional valuable resource. Computer terminals linked to the mainframe computers and personal computers are available in many of the laboratory areas. In addition, Martha Van Rensselaer Hall houses one of the general-access computer facilities with terminals connected to the mainframe computers and microcomputers for use by faculty members and students.

Faculty and Specializations

- C. C. Chu: design of textile materials for medical use; degradation and stabilization of fibers; thermal and crystallization properties
 D. T. Grubb: structure-property relationships in crystalline polymers; crystal morphology of fibers; electron microscopy
 S. B. Hester: international and domestic textile and apparel economics and marketing
 A. T. Lemley: textile dyes; toxic substances in water
 S. K. Obendorf: fiber microscopy and spectroscopy; textile chemistry; detergency and surface analysis; performance evaluation of fabrics and apparel
 S. L. Phoenix: statistical models of fiber bundles; fiber reinforced composites
 F. Rodriguez: polymerization; properties of polymer systems; polymers for electronics
 N. C. Saltford: textile legislation and marketing; clothing consumption practices
 P. Schwartz: mechanics of fiber structures; high-performance fibers; fiber-reinforced composites
 S. M. Watkins: functional apparel design
 V. White: science and technology of consumer textiles; textiles for apparel and interiors; standards development, national and international systems

Theatre Arts

Graduate Faculty Representative Stephen R. Cole, 212 Lincoln Hall

Major and Minor Subject (areas of concentration are in parentheses) For the M.A. and Ph.D.:

Theatre Arts (drama and the theatre, theatre history, theatre theory and aesthetics, directing [minor only], design for the theatre [minor only]); *for the M.F.A.*: Theatre Arts (acting)

For the M.A. and Ph.D. GRE aptitude test scores are required. Direct admission to the doctoral program is restricted to those with M.A. degrees.

For the M.F.A., interviews and audition sessions are required.

The normal language requirement for the Ph.D. 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. The program leading to the Master of Fine Arts degree in acting requires a minimum of three years in residence. The program emphasizes studio and workshop training as well as formal instruction. A final project replaces the conventional final examination. The M.F.A. is 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 are included to a meaningful extent 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, and most aspects of theatrical production.

Faculty and Specializations

F. Ahl: classics
R. Archer (M.F.A. only): theatre technology
R. Ascher: anthropology
A. Caputi: comparative literature
H. Cole (M.F.A. only): design
S. R. Cole: acting; directing; theatre aesthetics
R. Dressler (M.F.A. only): design
D. Feldshuh: directing; acting
D. Fredericksen: cinema theory and history
R. Gross: theatre theory and history; dramatic literature; playwriting
D. Grossvogel: comparative literature; Romance studies
M. Hays: dramatic literature; theatre theory and history
P. Lawler: dance
S. McMillin: English language and literature

Theoretical and Applied Mechanics

Graduate Faculty Representative S. Mukherjee, 223 Kimball Hall

Major and Minor Subject (areas of concentration are in parentheses) Theoretical and Applied Mechanics (dynamics and space mechanics, fluid mechanics, mechanics of materials, solid mechanics)

The program emphasizes the fundamental principles of engineering science and a strong foundation in applied mathematics, coupled with an appreciation 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 engineering, physics, and mathematics. Current research topics include (1) biodynamics, mathematical modeling of biological systems; (2) dynamics and space mechanics—stability and non-linear oscillations of particles, dynamical systems, bifurcation, planetary dynamics, celestial mechanics; (3) fluid mechanics—Newtonian and non-Newtonian fluids, liquid crystals, combustion, magnetogas-dynamics; (4) mechanics of materials—failure and fracture of solids, nondestructive testing, ultrasonics, static and dynamic properties of solids and fluids; (5) solid mechanics—wave propagation in solids, geomechanics, static and dynamic response of structures, contact problems, computational mechanics, elasticity, plasticity, creep, magnetosolid mechanics, continuum mechanics.

The field admits students with backgrounds in physics, mathematics, and any branch of engineering. Students applying for financial aid are expected to submit GRE scores.

Students enrolled in the Ph.D. program must take a qualifying examination before the start of the fourth term in residence. Each doctoral candidate must demonstrate reading ability in one language other than the native language. The field also requires teaching experience of all doctoral candidates.

Fellowships, teaching assistantships, and a limited number of research assistantships are available. Applications for assistantships are considered along with admission to the field; no separate form is needed.

Faculty

J. A. Burns, H. D. Conway, E. W. Hart, T. J. Healey, P. J. Holmes, C. Y. Hui, J. T. Jenkins, R. H. Lance, G. S. S. Ludford, F. C. Moon, S. Mukherjee, Y. H. Pao, R. H. Rand, A. L. Ruina, W. H. Sachse

Urban Studies

Graduate Faculty Representative Barclay G. Jones, 111 West Sibley Hall

Minor Subject Urban Studies

Urban studies is an interdisciplinary *minor* field that 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, management, and human development. It should develop the student's competence in such subject areas as processes of urban change, public policy and administration, theories of urbanization, urban ecology, urban economics, urban planning, urban political processes, and urban social structure. 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 Program in Urban and Regional Studies and through other University facilities.

Faculty and Specializations

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
B. G. Jones: city and regional planning
P. W. Martin: law
J. W. Reps: 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
H. Y. Wan: economics

Vegetable Crops

Graduate Faculty Representative Pamela Ludford,
163 Plant Science Building

Major and Minor Subject Vegetable Crops

The field offers graduate training leading to the Master of Professional Studies (Agriculture), M.S., and Ph.D. degrees. Students who want to obtain a Ph.D. are expected to obtain a master's first.

A good background in biological and agricultural sciences, together with an interest in economic plants, is desirable, and farm experience is an advantage. It is strongly recommended that applicants submit scores from the GRE aptitude test.

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 on 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 producers of seeds, agricultural chemicals, and food processors.

Facilities include ample greenhouse space; a bioclimatic laboratory complex, including cold-storage rooms; a pilot plant at Geneva; research farms at Ithaca, Geneva, and Riverhead, Long Island; 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., 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 are encouraged to obtain teaching experience.

Faculty and Specializations

R. R. Bellinder: weed science
M. H. Dickson: * vegetable breeding
L. A. Ellerbrock: vegetable production
E. E. Ewing: potato physiology
J. R. Hicks: postharvest physiology, marketing
P. M. Ludford: postharvest physiology
G. A. Marx: * vegetable breeding
P. L. Minotti: mineral nutrition
M. A. Mutschler: vegetable breeding
E. B. Oyer: international agriculture
N. H. Peck: * nutrition and cultural practices
R. W. Robinson: * vegetable breeding
S. Shannon: physiology
A. G. Taylor: * seed and vegetable science
L. D. Topoleski: greenhouse production
D. H. Wallace: vegetable breeding
H. C. Wien: physiology and cultural practices
D. A. Wilcox: cultural practices
D. W. Wolfe: production and varieties

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

Veterinary Medicine

Graduate Faculty Representative Leland
Carmichael, Baker Institute

Major and Minor Subject (areas of concentration are in parentheses) Veterinary Medicine (anatomy, bacteriology, epidemiology, immunology, parasitology, pathology, pharmacology, physiology, surgery, theriogenology [animal reproduction], veterinary medicine, virology)

Applicants should submit results of the GRE aptitude test. Scores of an advanced test are also desirable.

The D.V.M. degree is required of applicants for admission in the clinical areas of study.

The field does not require reading knowledge of a foreign language. However, 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 66,575 volumes and 1,100 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 virus disease laboratories, poultry disease facilities, and sheep and cattle disease farms.

Graduate students may work for the degrees of M.S. or Ph.D. A student who holds the D.V.M. from a recognized college in the United States or Canada may transfer one year's residence credit for that work toward the Ph.D. Combined D.V.M.-Ph.D. and D.V.M.-M.S. programs have been instituted for qualified students already enrolled in the professional degree program.

Faculty and Specializations

Anatomy

Comparative anatomy: H. E. Evans
 Comparative neurology: J. F. Cummings, A. deLahunta
 Developmental biology of connective tissues:
 R. R. Minor
 Embryology: H. E. Evans, R. R. Minor, D. M. Noden,
 W. O. Sack
 Functional anatomy of the digestive system:
 J. F. Cummings, W. O. Sack
 Radiological anatomy: V. T. Rendano

Animal Physiology

Absorption and blood flow in the gastrointestinal tract:
 A. Dobson
 Basement membrane; biosynthesis, secretion,
 deposition and turnover: R. R. Minor
 Behavior of domestic animals: K. A. Houpt
 Biological effects of radiation: A. P. Casarett
 Comparative physiology of food intake control:
 K. A. Houpt, T. R. Houpt
 Connective tissue: R. R. Minor
 Degenerative disease in hip joints: G. Lust
 Endocrine mechanisms: R. A. Corradino
 Environmental contamination; veterinary statistics:
 J. C. Thompson, Jr.
 Enzymology, protein structure-function relationships:
 J. F. Wootton
 Fission product metabolism: F. W. Lengemann
 Metabolism and nutrition: F. W. Lengemann
 Mineral metabolism: F. A. Kallfelz
 Mineral metabolism, intestinal absorption mechanisms,
 membrane transport: R. H. Wasserman
 Neurophysiology: E. L. Gasteiger, D. N. Tapper
 Reproductive and diagnostic endocrinology:
 T. J. Reimers
 Reproductive biology and endocrinology: W. Hansel
 Reproductive physiology: J. E. Fortune
 Ruminant metabolism: E. N. Bergman
 Urea metabolism: T. R. Houpt

Bacteriology

Bacterial depuration in shellfish: J. F. Timoney
 Bovine brucellosis: A. J. Winter
 Canine brucellosis: L. E. Carmichael
 Corynebacterial and mycobacterial infections:
 S. G. Campbell
 Erysipelas: J. F. Timoney
 Infections of finfish, shellfish, and waterfowl:
 L. Leibovitz
 Infections of the bovine reproductive tract: A. J. Winter
 Mycoplasma: J. Fabricant
 Pathogenic bacteriology and molecular biology:
 G. Dunny
 Plasmids: G. Dunny, J. F. Timoney
 Reproductive physiology and fetal development:
 P. W. Nathanielsz
 Salmonellosis: J. F. Timoney
 Streptococcal and staphylococcal diseases:
 N. L. Norcross
 Veterinary nuclear medicine: F. A. Kallfelz

Epidemiology

Dairy herd health: H. N. Erb
 Experimental epidemiology: R. H. Cypess
 Nutritional toxicology: J. G. Babish

Immunology

Autoimmune diseases: F. Quimby
 Cell-mediated immunity: V. L. Utermohlen
 Cellular and humoral immune responses:
 S. G. Campbell, R. H. Jacobson, N. L. Norcross,
 K. A. Schat, D. O. Slauson, J. F. Timoney
 Cellular resistance to infection: D. D. McGregor
 Immune response: S. G. Campbell
 Immunobiology: R. G. Bell
 Immunochemical studies of antigens: N. L. Norcross,
 A. J. Winter
 Immunogenetics: D. F. Antczak, F. Quimby,
 D. L. Wasson
 Secretory immunity: R. Bell, N. L. Norcross,
 A. J. Winter

Parasitology

Helminths: J. R. Georgi
 Host and parasite systems: J. R. Georgi
 Immunoparasitology: R. G. Bell, R. H. Cypess,
 R. H. Jacobson
 Parasitic diseases: J. R. Georgi

Pathology

Cells and mediators of inflammation: D. O. Slauson
 Comparative medicine: G. C. Poppensiek
 Comparative pulmonary pathology: D. O. Slauson
 Connective tissue disease: R. R. Minor
 Developmental pathology: R. R. Minor
 Diagnostic pathology: J. M. King
 Electron microscopy: R. R. Minor
 Immunopathology: R. M. Lewis, D. O. Slauson
 Infectious diseases: D. H. Schlafer
 Neuropathology: B. J. Cooper, B. A. Summers
 Oncology: K. M. Lee, F. Noronha
 Pathology of nutritional diseases: L. P. Krook
 Reproductive pathology: D. H. Lein, D. H. Schlafer
 Respiratory and hepatic pathology: W. L. Castleman

Pharmacology

Analytic chemistry and toxicology: J. D. Henion
 Diabetes and diarrheal diseases: G. W. G. Sharp
 Drug testing and toxicology: G. A. Maylin
 Immunopharmacology: C. Fewtrell
 Ion channels: R. E. Oswald
 Neuropharmacology and receptor mechanisms:
 G. A. Weiland
 Renal thyroid hormone metabolism: D. Ferguson
 Thyroid hormone and brain chemistry: W. S. Schwark

Surgery

General surgery: J. E. Lowe
 Orthopedic surgery: E. Trotter
 Pathophysiology of anesthesia: C. E. Short

Theriogenology (Animal Reproduction)

Equine reproduction: G. L. Woods
 Reproductive and diagnostic endocrinology:
 T. J. Reimers
 Reproductive pathology: D. H. Lein
 Reproductive physiology and fetal development:
 P. W. Nathanielsz

Veterinary Medicine

Biomechanics: J. E. Lowe, H. F. Schryver
 Clinical nutrition: H. F. Hintz, F. A. Kallfelz, J. E. Lowe,
 H. F. Schryver
 Comparative gastroenterology: F. A. Kallfelz,
 B. C. Tennant

Comparative neurology: J. F. Cummings, A. deLahunta
 Internal medicine: F. H. Fox, B. C. Tennant
 Preventive medicine: R. H. Cypess
 Radiology and nuclear medicine: F. A. Kallfelz

Virology

Aquatic diseases: J. H. Gillespie, J. M. King,
 L. Leibovitz
 Avian diseases: B. W. Calnek, J. Fabricant, K. Schat
 Bovine viral diseases: J. H. Gillespie, F. W. Scott
 Bovine winter dysentery: S. G. Campbell, F. W. Scott,
 B. C. Tennant
 Canine viral diseases: M. J. Appel, L. E. Carmichael
 Comparative medicine: G. C. Poppensiek
 Enteric infectious diseases: A. Torres-Medina
 Feline urolithiasis: J. H. Gillespie, L. P. Krook
 Feline viral diseases: J. H. Gillespie, K. M. Lee,
 F. W. Scott
 Pathogenesis: E. J. Dubovi
 Tumor viruses: K. M. Lee, F. Noronha
 Viral diseases: V. L. Utermohlen

Water Resources

Graduate Faculty Representative Douglas Haith,
 214 Riley-Robb 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 the combination of courses, seminars, and projects outside the major field that the Special Committee considers most appropriate to the interdisciplinary aspects of the degree program.

Students who select this minor are usually drawn from the following major fields, subjects, and areas of concentration: Agricultural Economics (Resource Economics), Agricultural Engineering (soil and water management), Agronomy (soil science), Management, Chemical Engineering, City and Regional Planning, Civil and Environmental Engineering (remote sensing, environmental systems engineering, hydraulics and hydrology, water resource systems), Ecology and Evolutionary Biology, Economics (economic theory), Geological Sciences (engineering geology), Natural Resources (aquatic science, fishery science), and Operations Research.

Faculty

D. J. Allee, L. B. Dworsky, D. A. Haith, D. P. Loucks,
 W. R. Lynn, B. T. Wilkins

Women's Studies

Graduate Faculty Representative Laura Brown,
 235 Goldwin Smith Hall

Minor Subject Women's Studies

Women's studies is a *minor* field of concentration at Cornell; a prospective student must be admitted to a *major* field of the Graduate School first and then may elect a minor in women's studies. The minor is interdisciplinary, representing a focus within general humanistic and social science scholarship. Women's studies includes not only the study of women but also the general investigation of sex roles and their significance. There are five core areas: history, literature, and the arts; psychology and human development; ideology and culture; institutions and society; and natural sciences.

Faculty

D. Bem, S. L. Bem, J. Blackall, L. Brown, J. Brumberg,
 W. K. Bryant, P. J. Carden, R. D. Colle, J. C. Condry,
 W. E. Cross, Jr., J. R. Egner, I. Ezergailis, J. Farley,
 J. Fortune, R. H. Frank, N. Furman, J. Gerner,
 D. Holmberg, R. M. Hutchens, B. J. Isbell, M. Jacobus,
 M. F. Katzenstein, I. Kramnick, W. W. Lambert, A. Lurie,
 K. S. March, C. Martin, S. McConnell-Ginet, F. B. Miller,
 M. B. Norton, E. K. Regan, S. Siegel, L. K. Williams

Zoology

Graduate Faculty Representative F. Harvey Pough,
 E211 Corson Hall

Major and Minor Subject (areas of concentration are in parentheses) Zoology (animal cytology, comparative and functional anatomy, developmental biology, ecology, histology)

Applicants must submit scores of the GRE aptitude test and advanced test in biology.

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 calculus, elementary physics, and organic chemistry.

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 many 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, cytology, developmental biology, histology and descriptive embryology, invertebrate zoology, and vertebrate zoology.

Faculty and Specializations

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
- R. R. Dietert: gene regulation for oncodevelopmental antigens; environmental and genetic factors influencing immune function
- H. E. Evans: comparative vertebrate morphology; the prenatal development of the dog
- K. A. R. Kennedy: human functional morphology; paleontology; evolution
- A. R. McCune: ichthyology; morphology; systematics; development; evolution; paleontology
- J. A. Marsh: developmental immunology; physiological parameters regulating immune system development and function
- D. M. Noden: mechanisms of craniofacial development; neuroembryology
- F. H. Pough: environmental physiology, especially of lower vertebrates; herpetology
- M. E. Richmond: mammalogy; terrestrial ecology; reproductive biology

Cornell University

Register

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Robert Barker, University Provost
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William D. Gurowitz, Vice President for Campus Affairs
Robert M. Matyas, Vice President for Facilities and
Business Operations
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Richard M. Ramin, Vice President for Public Affairs
James A. Sanderson, Chief Investment Officer
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Kenneth M. King, Vice Provost
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Walter J. Relihan, Jr., University Counsel and Secretary
of the Corporation
Joseph B. Bugliari, Dean of the University Faculty

Graduate School Administration

Alison P. Casarett, B.S., M.S., Ph.D., Dean of the
Graduate School
Gerard Cox, B.A., M.A., Ph.D., Associate Dean of the
Graduate School
Joycelyn R. Hart, B.A., M.S.S., Assistant Dean of the
Graduate School
Ken Strike, M.A., M.S., Ph.D., Secretary of the
Graduate Faculty

General Committee

Members-at-Large

Ralph Bolgiano, Jr. (1987)
Maurice Tauber (1987)
Karen Brazell (1988)
Billy Jean Isbell (1988)

Humanities

Dorothy Mermin (1987)
Neal Zaslaw (1988)

Social Sciences

Ronald G. Ehrenberg (1987)
Elaine Walker (1988)

Biological Sciences

Brian Chabot (1987)
Douglas McGregor (1988)

Physical Sciences

Lawrence E. Payne (1987)
Mark Nelkin (1988)

University Professors-at-Large

Professors-at-large are distinguished nonresident members of the University Faculty. During short visits to the campus of up to a month's duration, made at irregular intervals, they hold seminars, give public lectures, and consult informally with students and faculty.

Michelangelo Antonioni (film director)
Dulio Arigoni (chemist)
Michael Baxandall (art historian)
Norman E. Borlaug (plant scientist)
David R. Cox (statistician)
Jacques Derrida (philosopher, literary critic)
Sir Kenneth J. Dover (classicist)
Richard L. Garwin (physicist)
Paul Greengard (neurophysiologist)
John L. Heilbron (historian)
E. LeRoy Ladurie (historian)
Bernard Lewis (Islamicist)
László Lovász (mathematician)
Geoffrey Marshall (political theorist)
Adrienne Rich (poet)
Michael L. Rutter (psychiatrist)
Margery W. Shaw (geneticist, physician, lawyer)
Sir Richard Southwood (biologist)
John Szarkowski (photographer)
Eudora Welty (writer)
Harold W. Woolhouse (biologist)

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