UNIVERSITY OF MINNESOTA
Graduate School
Minutes of the Executive Committee
Thursday, December 11, 1969
170 BA - West Bank 1:00 P.M.

Present: Professors Alfred Caldwell, Frederick Forro, Jack Merwin, David Thompson, William Warner, William Wright, E. W. McDiarmid; Drs. Lewis Wannamaker, R. Drew Miller; Deans Francis Boddy, Millard Gieske, M. Harry Lease; Miss Beverly Miller, Assistant to the Dean; Graduate Student Representatives, Manley Olson, Ellen Schaffer, and Stephen Carpenter; Dean Bryce Crawford,Jr., presiding; Shirley McDonald, Secretary.

1. Graduate Student Organization - Dean Crawford introduced Miss Ellen Schaffer who will represent the graduate students in Zoology on the Executive Committee.

Mr. Carpenter, representing Art History, asked about the status of a questionnaire having to do with the payment of fees by students holding appointments even though they have finished all course work. Miss Schaffer said that the questionnaire is sponsored by ASTRA, and the results are being collated. The Graduate School will be informed when results are available.

The dean reported that information about a National Graduate Student Association proposed by the Graduate Students Association at UCLA will be sent to the student representatives on the Executive Committee. An inquiry about graduate student organizations at other institutions has been received from the Yale University Graduate Student Senate. This will also be sent to the student representatives.

The group committees are reminded to review the proposal that the microfilm fee be taken out of a general University fund. A statement on the history and purposes of the fee was distributed earlier.

Dean Crawford asked if there has been any reaction to the proposal on use of reprints of publications for the Master's and Doctor's theses, submitted for consideration by Mr. Olness for the Agriculture student group. Professor Wright said that the Social Sciences Group Committee believes that approval is not really necessary; what is proposed can be accomplished through existing rules. That committee did emphasize, however, that if the thesis is to be presented in a form suitable for publication, raw data, bibliography, and other archival materials should be appended to aid the thesis committee in its review and to provide accessible storage for supporting materials. The group committee suggested that information about this be disseminated, perhaps to all A-3 and B members of the Graduate Faculty. And word to the students might be spread through the Graduate Student Organization. Dean Boddy said that it must be made clear that the research has been carried out under the supervision of the student's adviser and before the article or the thesis is written. Dean Gieske pointed out that Graduate School rules require permission by thesis readers and advisers to publish prior to final approval of the entire thesis, and that this has not presented problems. The discussion will be carried forward pending review by the other group committees.

2. Meetings of Directors of Graduate Study, Admissions Officers, Graduate Deans (Refer to Executive Committee Minutes, Nov. 20, 1969 - item 2) - An agenda of suggested topics for the winter and spring quarter meetings was distributed to the Executive Committee. Dean Crawford asked that these be considered by

the group committees; the Directors and Admissions Officers will also be asked for their thoughts about the items. The agenda will then be re-worked and sent out prior to the winter quarter meeting.

3. An Ad-hoc Committee on Admissions Policies - Dean Crawford said that some of the points brought out in the fall quarter meeting of the Directors and Admissions personnel might well be studied by an ad hoc committee on admissions policies. This committee would review current policies; it would not make individual case judgments, but develop general policy to cover atypical situations as they arise. Such a committee could also explore ways to recruit the better graduate students--departmentally and centrally. It was suggested that validation studies of our admissions criteria be made. This ad hoc committee might initiate such studies, not necessarily across the board, but by some separate fields. Composition of the committee was discussed. It was agreed, generally, that there be graduate student representation. Perhaps a post doctoral student who received his training at another institution, might be interested in comparisons, and a foreign student might also make a significant contribution to the committee's deliberations. The dean said that he will consult with the group committee chairmen regarding appropriate faculty from their areas for membership and will also want suggestions for student membership.

4. Proposed Doctor of Arts Degree - A number of institutions have been working towards the development of a graduate program equal to the Ph.D. in the mastery of the field, but not so completely oriented towards research nor so narrowly focused as the Ph.D. This would probably be a three or four year program of study with a moderate specialization, a synthesis of existing materials rather than original research, and a teaching internship. Dean Crawford said that the Council of Graduate Schools will have a statement soon and this along with information about the programs at Carnegie Mellon University and the University of Washington will be sent to the group committees, graduate student representatives, and the Directors of Graduate Studies.

   Dean Boddy said that it will be important to have graduate student input; Mr. Olson said that students would not wish to see just a change in the label and parts of an existing program. Professor Forro expressed concern as to the reaction universities would have toward this kind of degree. Dean Crawford said that a university should not endorse it unless holders of the degree will be eligible for appointment, retention, and promotion by that institution.

5. The Foreign Language Requirement (Refer to Executive Committee Minutes, Oct. 8, 1969 - item 6 and Nov. 20, 1969 - item 5) - Miss Miller announced that she has sent out the follow-up memo to departments which have not sent proposals for the foreign language requirement for their fields. The proposals are being referred to the group committees and, as they are approved, the Graduate School will notify the departments so that they may begin to operate under the new regulations. Some fields will wish to retain the present requirement. A statement to that effect plus the reasons for the decision should be sent to the Graduate School.

6. The Registration Permit (Refer to Executive Committee Minutes, June 4, 1969- item 4) - In early December, a memorandum on the proposed Registration Permit was sent to Executive Committee members. The memorandum reviewed the reasons for the permit and outlines recommendations to be made to the various fields as to what the guidelines should be in determining when to issue "warning" permits and "holds." Considerable discussion ensued with concern expressed

about a set number of Incompletes and the timing for the submission of programs. Members wondered if there should not be more flexibility since many advisers would not wish to commit themselves on programs so early. There might also be complications on the timing of departmental comprehensive examinations and the submission of programs; in some departments, continuation in the Ph.D. program depends somewhat upon performance on these examinations.

The Committee suggested that these items be adjusted as follows:

> Incompletes - A total of 3, 6, 9, or 12 credits of "I" (or courses with no grade) including courses in which a student may be offering Plan B papers.
>
> Master's Program: For the regular Plan A and Plan B degrees, to be called for after 15 credits of completed work (or work registered for).
>
> Ph.D. Program: To be called for at the end of 3, 4, or 5 quarters in residence.

The adjusted memorandum will be sent to the Directors of Graduate Study. They are encouraged to check with the group committee chairmen or the Graduate School if they have questions or suggestions. The Graduate School may have to decide the formulae which can be accomplished by the present use of the computer facility.

7. Composition of Examining Committees - Internal Supporting Program
Professor Wright stated that the Social Sciences Group Committee asked him to bring before the Executive Committee a question about examining committees for students using the Internal Supporting Program. One might argue that if competency in the field is to be tested, the committee should consist of five members from the major field. However, if narrowness is to be avoided and university-wide standards maintained, there should be one person outside the major on the committee. Also there is the technical problem of the faculty person who holds a joint appointment on the Graduate Faculty; can he serve on the examining committee "wearing either hat?" Dean Crawford said that there would need to be a judgment made as to where the person's primary loyalties lie. Committee composition will be one of the topics discussed in future meetings of the Directors of Graduate Studies and this aspect will, no doubt, receive attention.

8. Proposed Change in Graduate Programs in Chemistry (Refer to Executive Committee Minutes, Nov. 20, 1969 - item 4C) - Dr. Wannamaker reported that the question about possible overlap between the existing Biochemistry major and the Bio-physical and Bio-organic Chemistry had been satisfied and that the Medical Sciences Group Committee has no further reservations in respect to the unified Chemistry program. Professor Forro expressed satisfaction regarding the present situation, with the reservation that future developments could lead to undesirable "competition" and that watchfulness was indicated; specifically that good communication and mutual awareness should be urged on all three departments involved.

9. Proposed Change in the Graduate Program in Political Science - The proposal explains that this program represents modifications necessary in order to keep in step with a discipline which is changing. The program emphasizes training in a specialized subfield but provides, also, for a general background to permit students to shift interest at a later date. Another facet is that

of the comparative study of political behavior; the study is no longer only American. There is a desire to expand cross-national comparisons in order to better understand political institutions and put them into some kind of comparative perspective.

The department will keep the option of the Master's degree for the time being for a screening device. But the absolute requirement that the Master's degree precede entry into the Ph.D. program has been removed which will eliminate the delay which the better students have experienced. There will also be a special program for a terminal Master's degree.

Professor Wright reported that there had been some discussion at an earlier Social Sciences Group Committee meeting about the new methodology courses developed in order to expand offerings in this area. The discussion centered about the proliferation of statistics courses in a number of departments and the need for centralization. But realizing the need for Political Science to make plans and the fact that the new School of Statistics will be concerned with coordinating statistics offerings, the group committee recommended that the proposal be accepted. Dean Crawford asked Dean Gieske to check with appropriate statisticians about these courses and with this understanding, the Executive Committee approved the program changes in Political Science.

10. Proposed Graduate Programs

A. M.S. and Ph.D. with a Major in Ecology - a third version of the proposal for programs in Ecology has been widely circulated and reviewed by faculty and units interested in ecology and animal behavior.

The proposal enumerates areas of specialization which do not represent all of the subfields possible with Ecology, but illustrate major foci of interest of the present faculty: (1) Population Ecology: the study of factors influencing the numbers of animals and plants in nature; (2) Ecosystems: the study of the structure and functioning of communities of animals and plants in relation to the environment; (3) Paleoecology: the study of past environments; (4) Limnology: the study of lakes, streams and rivers; (5) Physiological ecology: physiological adaptations of plants and animals; (6) Eco-ethology:behavioral adaptations, social behavior, communication in animals; (7) Behavioral physiology: neural and endocrine mechanisms involved in animal behavior.[1]

The above fields are interrelated in various ways; the proposal describes how they are also associated with allied disciplines. The relationship of subfields within Ecology to other areas of knowledge is covered. The proposal also explains the need for graduate programs in Ecology and talks abour the trends in research. Information about Graduate Faculty resources, facilities and equipment is included. Admissions procedures, checks on student progress and general program requirements are outlined. Typical Master's and Ph.D. programs are appended.

Professor Forro reported that following the review of the revised proposal, the Biological Sciences and Agriculture Group Committees recommend that the program be accepted.

The Executive Committee approved. A copy of the complete proposal is bound with the permanent file of these minutes.

1 from the proposal

B. Proposed M.S. and Ph.D. with a Major in Mycology - before the Agriculture and Biological Sciences Group Committees.

C. M.S. and Ph.D. with a Major in Operations Research - Physical Sciences and Social Sciences Group Committees are reviewing.

The meeting was adjourned.

Respectfully submitted,

Shirley McDonald,
Secretary

December 22, 1969

UNIVERSITY OF *Minnesota*

DEPARTMENT OF POLITICAL SCIENCE
1414 SOCIAL SCIENCES BUILDING · MINNEAPOLIS, MINNESOTA 55455

October 13, 1969

Dean Bryce Crawford, Jr.
University of Minnesota
Graduate School
321 Johnston Hall
Minneapolis, Minnesota 55455

Dear Dean Crawford:

Enclosed is a copy of the description of the Political Science Department's proposed new curriculum for our graduate program. I am writing to request that you review this proposal which includes, as you will note, some restructuring of fields and the proposed use of certain diagnostic exams to waive requirements for the M.A. degree for our better students, and to bring this proposal before the Graduate Group Committee for its review and action.

Professor John Turner, former Director of Graduate Studies in the Political Science Department, sits on the Social Science Group Committee and will be able to make whatever formal presentation may be desired by the Group Committee.

We believe that this new structure of our graduate program will make graduate study in political science here at Minnesota administratively more efficient both for the faculty and for students and will provide a more carefully thought out set of fields for graduate study to accord with the major concerns of the discipline.

If you have any questions regarding this proposed new program, for which we seek approval, please don't hesitate to contact me.

Sincerely,

Eugene Eidenberg

Eugene Eidenberg
Director of Graduate Studies

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September, 1969

The Program in Graduate Instruction

Political Science

University of Minnesota

Political Science is a rapidly changing discipline. Several facets of the discipline which were the esoteric interests of just a few scholars ten years ago are today central concerns of the discipline. As the discipline changes, it is necessary to make modifications in the program of graduate instruction to provide students with the opportunity to keep abreast, or even ahead, of the changing discipline without losing sight of the central problems.

The Department of Political Science is introducing a new graduate program beginning in the Fall of 1969. While there were many reasons for making the modifications, three are of central importance.

1. Specialization and General Training. One of the major purposes of the Ph.D. program is to prepare scholars for teaching and research in a specialized subfield of the discipline. Thus it is necessary to provide course work and research opportunities that allow the student, in consultation with his advisor, to become well qualified in the specialized area of his choice. But in a rapidly changing field, such specialization is not enough. The exciting field of specialization today may be of little importance tomorrow. Therefore, a second important purpose of a Ph.D. program is to provide a broad enough background to enable the scholar to shift his interests at some future date on the basis of an intelligent assessment of the field. The program outlined below is an attempt to provide for an optimal mix of specialized training and general background.

2. A Comparative and International Outlook. In the past a good deal of political science in the United States has been oriented around the empirical study of American government. When the sub-field of political behavior emerged as a central concern in the discipline in the last decade, its data base was almost exclusively American. The new program attempts to broaden this and to encourage the student to look at political phenomena in a comparative as well as in an American perspective. We do not intend to downgrade the study of American government but rather to enrich it, viewing it in a comparative perspective, and at the same time to encourage students of foreign governments to have some familiarity with the American scene.

3. A More Flexible Program. While the above objectives are important, there is a number of ways in which they may be achieved. The new program is designed to increase the number of options open to a student so that he can, in consultation with his advisor, choose within broad limits the manner in which he will put together his program.

1. For the purpose of facilitating the achievement of the above objectives, the discipline of political science has been broken down into six fields, four of which may be chosen as first and second fields of concentration for purposes of the preliminary examination. The fields of concentration are:

   A. Political Theory

   B. Political Processes and Behavior

   C. International Politics

   D. Law and Public Policy

Other fields in which students may <u>not</u> concentrate are:

   E. Area Courses

   F. Methodology

(See appendix to this report for a listing of courses by field.)

II. Requirements for the Ph.D.

A. The major programs. Each student will be required to have 57 credits in his major program or the equivalent of 19 seminars. He will prepare himself in two fields of concentration in which he will be examined in the preliminary examinations. In the first of these fields, he will normally be expected to take six seminars, and in the second, he will normally be required to have four seminars, but the student and his advisor can decide on some other division if they think it is appropriate in an individual case. In addition, he is required to complete Pol. 200 and 201 during his first year of graduate work and is urged (although not required) to complete two additional seminars in methodology by the end of his second year.

One or more research seminars will be offered in each of the fields of concentration each year. The topics dealt with in these seminars will vary from year to year, depending upon the interests of the students and the faculty. Students will be required to take one research seminar during the first year (normally in the winter or in the spring quarter) and will be required to turn in their research papers before the beginning of the next academic year. (The timing of this requirement is to allow the student, if he desires, the opportunity to work on the paper during the summer between the first and second year.) A second research paper, normally undertaken as part of another research seminar, must be completed before the Ph.D. preliminary examination. Papers completed in these research seminars would most likely fit into M.A. requirements as Plan B papers and could be expanded to meet the requirements of a Plan A masters thesis. (See the description of M.A. program below.)

To summarize the normal requirements for major program:

6 seminars in the first field
4 seminars in the second field
2 seminars in scope and methods (Pol 200 and 201)
2 research seminars
5 seminars elective (students are advised to take two of these in methodology and to take the other three outside of their two fields of concentration; in any event, at least three seminars must be outside of the two fields of concentration.)

B. The Minor or Supporting Program. The Graduate School requires that each student complete a Minor or supporting program which consists of at least one-sixth of the total program taken in courses numbered over 100. Normally, this means 18 credits. A minor consists of work done in a single department while a supporting program consists of courses taken in several disciplines and which relate to and support the major. If the student chooses the supporting program, he may elect to make a maximum of two courses in field E and/or F above a part of that supporting program (with the exception of Pol 200 and 201). For example, if a student decides that he wants to take a supporting program in East Asian studies to support his major, he could take courses in Anthropology, History and Geography plus Pol. 222 (Japan) and Pol 223 (China). Pol 222 and 223 in this example would not be part of his major program and thus not part of the required 19 seminars.

C. Foreign Languages and Research Tools. Each student must satisfy a foreign language or research tool requirement. The Department provides four options:

1. The student must pass the reading exam offered by the relevant language department in two foreign languages. (Course work may not be offered in lieu of passing the exams, although the various language departments do offer courses for graduate students whose final exams can be taken for the purpose of meeting this requirement.)

2. The student may show advanced competence in a single language which is related to his research interests. Advanced competence will normally mean demonstrating that the language can be used in field research.

3. The student must pass the reading exam offered by the relevant language department and demonstrate competence in a research tool. Nine credits in a 100 level course or its equivalent will be considered demonstrated competence.

4. The student must show advanced competence in a research tool normally equivalent to at least 18 credits in 100 level courses.

The option that the student chooses and the specific way of meeting that option must be approved by his advisor and the Graduate Work Committee.

D. Preliminary Examinations. Two preliminary examinations will be prepared in each field of concentration. One will be a more comprehensive exam to be taken by those students who elect the field as the first field of examination and the other to be taken by all students who elect that field. Therefore, each student will be writing three preliminary examinations in his major--two in his first field and one in his second. The exams will be eight hours in the first field and four hours in the second.

Examinations in the minor or related field will be governed by Graduate School rules. Generally, students are examined in their minor field by their minor department, while students presenting supporting programs are not generally examined. However, all students are examined in their minor or supporting program in the preliminary oral.

III. Masters Programs

A. The Major Program: Plan A. The work leading to the Master's degree under Plan A consists of at least three (3) quarters of graduate study, including: (a) in addition to Pol 200 and 201, at least 18 credits in Political Science; (b) at least 9 credits in the minor department comprising either a 9 credit course of a sequence of related courses totaling 9 credits; (c) a substantial thesis based upon independent research; (d) successful completion of a written examination in two (2) subfields presented and a final oral examination covering these subfields and the thesis.

B. The Major Program: Plan B. Candidates for the Master's degree without thesis must complete: (a) in addition to Pol 200 and 201, at least 18-24 credits of course work in Political Science seminars chosen from either two or three subfields; (b) a minimum of from 18-24 credits of course work in at least two related disciplines; (c) research papers as specified in the requirements of the Graduate School (i.e. three (3) research papers done for seminars representing 9 credits of course work); (d) a final written examination covering the two (2) subfields presented and an oral examination covering these and the research paper. Courses elected in Political Science together with those in the related fields should constitute an integrated plan of study. Normally, at least two (2) of the required research papers, if submitted in 3 credit courses, or one, if submitted in a 6 or 9 credit course, should be prepared for courses in the field of concentration.

Students working for a Master's degree may not register for course work in Political Science beyond the Master's requirements until they are admitted to the Ph. D. track by the Department.

Special M.A. Program. Those students who enter with the intention of seeking a terminal M.A. degree, may elect to follow a special course work program in which some 100 level courses in Political Science are accepted for Master's credit. This special program must be approved by the student's advisor and the Graduate Work Committee of the Department.

It should be understood that this special terminal M.A, program will not prepare a student for the Department's Ph.D. program. Those students who are uncertain at the start of their graduate work as to their plans to pursue a Ph.D. program are advised not to elect this special terminal M.A. program. Students in this special program are not required to take either Pol 201 or the first year diagnostic exam (explained below). They will, however, take an M.A. exam at the completion of course and research requirements for the M.A. degree. These students normally will follow the Plan B program to the M.A. degree.

IV. Minor in Political Science

A. M.A. Minor in Political Science. Candidates for graduate degrees with Political Science as the minor must take at least one 9 credit course or a group of related courses lying in either one or two subfields and totaling 9 credits. Either graduate level or 100 level courses may be used.

B. Ph.D. Minor in Political Science. A candidate for the Ph.D. degree who elects political science as his minor shall prepare himself for examination in one or two subfields, completing courses at least sufficient to satisfy the minor requirements of the Graduate School. If he concentrates in one subfield he must include 9 credits of 200 level courses; if he chooses two subfields he must include one 3 credit 200 level course in each.

V. Independent Study.

The Department recognizes the special value of independent study for students interested in pursuing a specific inquiry under more intensive direction than can normally be provided in a seminar. However, the Department also is concerned that it maintain the efficient use of its teaching resources, a goal that cannot be realized if there is no limit to the number of independent study courses students take. Therefore, it is the Department's policy to restrict independent study to a maximum of six hours for any one student, and the proposed program of independent study must be approved by the Graduate Work Committee of the Department and the proposed instructor. Any exception to this requires the advance approval of the Graduate Work Committee and the student's advisor.

VI. Student Evaluation and Counseling. All first year students must take a diagnostic exam at the end of their first year of work. It is expected that students will take this exam during the spring quarter of their first year. Students who take the exam in the spring and who are not satisfied with the results or for other reasons may not have taken the exam in the Spring may, at their request, take the examination in the fall. The diagnostic exam will be a written test to be followed by an oral exam if in the discretion of the readers, this is necessary to reach a final recommendation.

The faculty committee which will make up and evaluate the diagnostic examination will be made up of those who have taught Pol 200 and 201 to that group of students plus one person from each of the four fields of concentration who has given a research seminar in that year. This committee shall evaluate the students' performance in the diagnostic examination, in his seminar work and in his research. On the basis of this evaluation, the student will be advised to take one of three courses of action:

1. enter directly into a Ph.D. program, by-passing the normal requirements for the Master's degree;
2. enter into a Master's program with the understanding that this will most likely be a terminal Master's program; however, at the completion of the preliminary examination and research work for the M.A., this decision would be reconsidered;
3. the student would be advised to drop out of the graduate program.

The review and recommendations of this committee on what program each student should enter shall be presented to the department before its last regular meeting in the spring quarter.

No student shall be given Departmental financial support for a third year in residence unless he has completed either the diagnostic examination, the Master's preliminary examination, or the Ph.D. preliminary examination. Students entering the program with a Master's degree may be requested by their advisor or by the Graduate Work Committee to take the first year diagnostic examination either in the spring of their first year or the fall of their second year.

A student, who on the basis of the diagnostic examination and on the basis of other evaluations, is allowed to go directly into a Ph.D. program, may apply for a Master's degree after the completion of the Ph.D. prelims and the necessary research. In other words, the research papers which are done as part of the research seminars could be used as Plan B papers (or, with expansion, as a Plan A Master's thesis) and the Ph.D. preliminary written and oral examination could be treated for this purpose as satisfying the Graduate School requirements for the Master's degree examinations.

There will be a Spring evaluation of all graduate students of advanced standing, that is, all second and third year students. At this time, there will be a preliminary review of the work of first year students based on their course work and Professors' evaluations. The precumption of this review of first year students will be that each one is doing satisfactory work unless there is strong evidence to the contrary.

Students entering the graduate program at the University of Minnesota with significant graduate work and/or a Master's degree from another institution must present transcripts and copies of any significant research papers to his advisor. His advisor will make the decision of which of the requirements of the Minnesota program have been met. This is particularly important in regard to the requirements for Pol 200 and 201, and to the requirements for a first year research seminar which yields a significant research paper.

VII. Structure of Graduate Work. Each graduate student should have a working understanding of the functions and responsibilities of the several Department and University jurisdictions that make policy affecting graduate study here at Minnesota. Much time and frustration can be avoided if the student knows where to go to get questions answered.

A. Advisors. Each student will be assigned an advisor within the Department. The assignment will be made in accordance with the students preference, the subject area within which he is working and an assessment of the advising responsibilities already being assumed by the prespective advisor. The single most important source of information, guidance, and support for the graduate student will be his Departmental advisor. He is the one with whom the student should be in most frequent contact. Because this relationship is so important to one's graduate career, students should not hesitate to seek advise and counsel from his advisor, or to seek a new advisor if that is desirable for any reason. Since the assignment of the advisor depends on the student's knowledge of faculty, the Director of Graduate Studies will sign first quarter registration forms.

B. Director of Graduate Studies. The office of the Director of Graduate Studies is the major Departmental repository of records and administrative decision-making authority for the graduate program. Routine decisions and information about Departmental policy can be secured from this office. Each graduate student ought to make an effort to visit the Director of Graduate Studies to permit him the opportunity of meeting each student individually.

C. Graduate Work Committee. The Graduate Work Committee is a four member committee (three members plus the Director of Graduate Studies) which makes most of the decisions implementing departmental policy as it affects the graduate program. This is the committee that receives and acts on all petitions seeking exceptions and/or permission for particular matters affecting individual students. The Graduate Work Committee screens applications for admission to graduate study in political science, and otherwise acts in the Departments name to execute its broad policy. In addition, the Graduate Work Committee is a body that can initiate policy changes by taking various recommendations to the full Department for its consideration. If and when students want to bring information or proposals regarding the operation of the graduate program to the attention of the faculty, the Director of Graduate Studies or the Graduate Work Committee are the logical recipients of such communications. The Department welcomes the active and regular involvement of its graduate students with the operation of the program. Every student should feel free to share his concerns about the program with either the Director of Graduate Studies, or members of the Graduate Work Committee. Two students selected by their peers will serve on the Graduate Work Committee participating in its actions on all questions save those involving judgements about fellow students or prospective students.

D. Graduate Group Committee. The Social Sciences Graduate Group Committee, acting in the name of the University Graduate School approves graduate student programs and departmental recommendations to deviate from any Graduate School rule. The Graduate Group Committee is an inter-disciplinary social science faculty committee acting in an advisory capacity to the administration of the Graduate School. The Graduate Group Committee, among its other duties, is responsible for assigning faculty to graduate oral examination committees. The Department has a representative on the Group Committee and he can be consulted on specific problems.

E. The Graduate School. The Graduate School is the central administrative agency of the graduate program, its Dean is Bryce Crawford. His office and that of the Graduate School are in 316 Johnston Hall on the East Bank of the University. These offices are open from 8:00 a.m. to 12:00 noon, and from 1:00 p.m. to 4:00 p.m. Monday through Friday.

F. Petitions. As is the case with any structure of rules, there must be some flexibility of interpretation and application. Any rule of the Department is subject to waiver if the reasons behind such a request seem to the Graduate Work Committee to justify the exception. Any such request must come to the Graduate Work Committee in written petition form (available from the Director of Graduate Studies) with the advisory comments of the student's advisor attached.

APPENDIX

PROPOSED COURSES BY APPROPRIATE AREAS

	*Old course numbering
Methodology (Not for exam in new programs)	
Methods of Scientific Inquiry and Explanation	200
Methods of Justification	201
Methods of Data Analysis	
Methods of Data Analysis	
Advanced Statistics in Political Analysis	
Comparative Methods	232
Political Theory	
Development of Political Thought	205A
Development of Political Thought	205B
Development of Political Thought	205C
Classics of Political Thought	208A
Classics of Political Thought	208B
20th Century Political Thought	210 A, B
American Political Thought	214 A, B
Contemporary Political Theory	212A
Contemporary Political Theory	212B
Contemporary Political Theory	212C
Formal Models	
Theory of Pluralistic Politics	228
Theory of Authoritarian Politics	229
Theory of Political Development	230
Selected Topics in Political Theory	216 A, B
Individual Reading	219 A, B, C
Research Seminar	216C
Political Processes and Behavior	
Public Opinion and Political Participation	250
Political Parties	251
Interest Groups	252
Political Leadership	255
Political Psychology and Socialization	256
Legislative Process	260
Executive Process	261
Judicial Process	262
Organizational Behavior	253
Community Power Systems	264
Local Government	265
Comparative State Politics	267
Individual Reading	259 A, B, C
Research Seminar	258 A, B

* no number indicates a proposed new course

International Politics

International Politics	235A
International Politics	235B
Regional Political Systems (?)	
International Organization	238A
International Organization	238B
International Law	241A
International Law	241B
Foreign Policy Making	245
Foreign Policy	246
Defense Policy	
Individual Readings	249 A, B, C
Research Seminar	236

Law and Public Policy

Administrative Law	285
Constitutional Law	290A
Constitutional Law	290B
Fundamental Concepts of Public Law	295A
Jurisprudence	295B
Law and Society	
Law and Society	
Public Policy	266
Public Policy	
Public Policy	
Intergovernmental Relations	263
Individual Reading	299 A, B, C
Research Seminar	292

Area Courses (Not for exam in new programs)

Western Europe	220A
Western Europe	220B
Soviet Union	221
Japan	222
China	223
India and South East Asia	224
Latin America	226
American National Government	
Africa	
Scandanavia	225

Prop. # 3 7(a)
final proposal appd.

UNIVERSITY OF MINNESOTA
Dept. of Ecology & Behavioral Biology

November 11, 1969

Dr. Bruce Crawford
Dean of Graduate School
321 Johnston Hall

Dear Dean Crawford:

I enclose a proposal to establish graduate degrees in Ecology at the University of Minnesota. I hope that it can be reviewed by the graduate group committees in their December meeting.

Two earlier versions of this proposal were prepared. The first was reviewed by the Biological and Agricultural Graduate Group Committees in April, 1969 and was judged unacceptable. The second version was widely circulated to interested units within the University in June 1969 and was critically reviewed by virtually all faculty members with interests in ecology and animal behavior This third version incorporates additions and corrections suggested by reviewers and provides a more detailed statement of the nature and scope of the proposed degree programs. We believe that it does not differ sufficiently from the second version to require additional review by departments which have already indicated their approval. However, the following faculty members have reviewed this expanded proposal: R.D. Bright, A.E. Erickson, R. E. Phillips, E.L. Schmidt, E. Gorham, W.H. Marshall.

Special attention has been given to the following points on which we were asked to elaborate:

1. The field covered by Ecology; trends in research and developing theory; major journals and societies.
2. What is to be the fate of "Behavioral Biology"? Is it being buried by the emphasis on "Ecology"?
3. Facilities and equipment available; sources of financial support.
4. How will the degree program be administered? How will applicants be evaluated and how will the progress of each student be monitored?
5. What is the rationale used in formulating student programs?
6. How can a minor in ecology be arranged?
7. What sorts of positions will graduates fill after successful completion of degrees?

Could you please enclose copies of this letter when the proposal is circulated for review?

Yours sincerely,

Alan J. Brook
Professor and Head

cc: Advisory Committee members

PROPOSAL TO ESTABLISH GRADUATE DEGREES IN ECOLOGY IN THE UNIVERSITY OF MINNESOTA

Over the last ten years many faculty members at the University of Minnesota have felt the need to bring more attention to the field of ecology, and attempts have been made to encourage closer contact among ecologists located in various departments and colleges. These attempts culminated in 1964 in a proposal to establish Ecology as a field of graduate study. Later, with the creation of the College of Biological Sciences, a more formal step was taken in the establishment of a Department of Ecology and Behavioral Biology as a companion unit to the Departments of Zoology, Botany, and Biochemistry and the newly formed Department of Genetics and Cell Biology. As we stand now, there is an interdepartmental graduate faculty in Ecology (under the Biology "umbrella") and a Department of Ecology and Behavioral Biology. Neither of these "units" includes all the ecologists in the University, but they do represent focal points for both graduate and undergraduate training in the basic aspects of ecology and behavioral biology. Currently staff from the Departments of Animal Science, Botany, Entomology Fisheries and Wildlife, Soil Science, and Zoology are involved as well as faculty from the School of Forestry, Limnological Research Center and J.F. Bell Museum of Natural History.

A logical step in giving the field the prominence it should have in the University is the establishment of graduate degrees. The urgent need to recognize "Ecology" as a major and minor area of study at both the M.S. and Ph.D. levels is indicated by heavy demand from both students and faculty.

The Field to be Covered by Graduate Degrees in Ecology

It is no easy matter to define the limits of this field of study; the boundaries are vague, and are constantly changing as new fields of specialization

emerge and the advantages of novel interdisciplinary approaches and new techniques are recognized. Because of their fundamental interest in the interrelationships between living organisms and the physical environment, ecologists make use of knowledge derived from a great many disciplines. Indeed, the range of possible relevant fields is almost unlimited, and ecology may be expected to become even more diverse in the future as interests develop in new directions. The field is growing very rapidly and its future scope is difficult to predict.

At the moment, the following seven areas of specialization are recognized for the Ph.D. written examination in Biology (Ecology). While they must not be taken to represent all the possible subfields within ecology, they serve to illustrate the major foci of interests represented by our present faculty:

(1) Population ecology: the study of factors influencing the numbers of animals and plants in nature.

(2) Ecosystems: the study of the structure and functioning of communities of animals and plants in relation to the environment.

(3) Paleoecology: the study of past environments.

(4) Limnology: the study of lakes, streams and rivers.

(5) Physiological ecology: physiological adaptations of plants and animals.

(6) Eco-ethology: behavioral adaptations, social behavior, communication in animals.

(7) Behavioral physiology: neural and endocrine mechanisms involved in animal behavior.

It should be stressed that these fields are all interrelated in various ways, some very closely, others remotely. Some are intimately associated with allied disciplines e.g. physics, chemistry, geology, pedology, and meteorology

in the case of ecosystems, paleoecology, and limnology; various aspects of systematics, genetics and evolution in the case of population ecology and ecoethology; biochemistry and anatomy in the case of physiological ecology and behavioral physiology. But the complexity of the relationships among these fields is compounded by the parallel existence of a bewildering array of related disciplines such as population genetics, geochemistry, water chemistry, plant physiology, physiological psychology, comparative psychology, behavior genetics, human ecology. Many of these fields are recognized areas of graduate training or they are encompassed by departmental or program majors such as those in Botany, Zoology, Geology, Physiology, Psychology, etc. In addition, of course, research is carried out by ecologists at various other levels with specialized subfields identified by groups of organisms (algal ecology, microbial ecology, avian ethology, primate sociology), by techniques (biotelemetry, brain stimulation, palynology, biochemical taxonomy), or by concepts or processes (biogeochemical cycling, bioenergetics, orientation, perception, imprinting).

We have stressed the great diversity of subdisciplines which can be grouped under "ecology and behavioral biology". There are unifying elements, however, and everyone working in this field is aware of characteristics that distinguish most ecologists and ethologists. The need to maintain close familiarity with natural ecosystems through personal field experience is widely recognized. Thinking in terms of complex systems involving a great many interacting elements is frequently looked upon as a challenge rather than a hopeless task. Asking broad evolutionary questions in terms of the population, the species, or the community comes as a natural outgrowth of familiarity with complex interactions in the field.

To attempt to define these fields by pointing to the major journals and societies can be misleading. Certainly we can mention such journals as Ecology,

Ecological Monographs, Oikos, Limnology and Oceanography, Journal of Animal Ecology, Journal of Applied Ecology, Journal of Ecology, Bioscience, Behaviour, Animal Behaviour, Zeitschrift für Tierpsychologie as major outlets for research. In all subfields, however, many of the key papers appear in a multitude of diverse kinds of journals, for example those dealing with special groups of animals. The difficulties of keeping abreast of rapidly developing interdisciplinary fields is especially acute and, for those researchers slightly out of the mainstream, personal contacts with key workers through correspondence or at meetings provide the only hope. The explosion in published information is one of the main reasons for increasing specialization. Attendance at several key meetings each year is almost essential. The meetings of the Ecological Society and Animal Behavior Society, the International Ethological Conferences, and the International Limnological Congresses are frequent choices, but specialized symposia are becoming very common in all subfields.

With such a vast field and so many interrelated subdisciplines, what is to be gained by attempting to draw them together under the rubric "Ecology"? Viable groupings of faculty and students seem to grow naturally through the need to exchange views and information of mutual interest and benefit. With the current proliferation of "areas", "fields", and "programs" all faculty members and graduate students have major decisions to make on where their prime emphasis will be. Since the formation of the Department of Ecology and Behavioral Biology there has been an overwhelming demand from both undergraduates and graduate students for information, instruction, and advice on matters relating to ecology and animal behavior. This intense interest is understandable in view of the relevance of these topics to current human problems. Clearly there is a demand from students to specialize in ecological and ethological aspects of biology. Advantages to the faculty in the form of mutual stimulation

and exchange of information are obvious.

Relationship to Other Degree Programs and Areas of Knowledge

By their nature, most of the subfields within ecology depend heavily on other disciplines. Some of these relationships have been indicated above. Of fundamental significance are the parent disciplines of Zoology and Botany, but many other fields are involved. Basic ecological research is being carried out in several departments within the Institute of Agriculture and in a number of other departments in the university. An earlier version of this proposal was circulated to all interested units (Appendix I) and many comments were received. There were many suggested corrections and additions, which are incorporated here, but in general the proposal was greeted favorably. Many departments expressed enthusiasm for the proposal and indicated a desire to have some of their students minor in Ecology.

Some comment is required on the relationship of the proposed degrees to fields with strong emphasis on "applied" aspects of ecology. It is impossible to neglect the influence of man on his environment in considering present-day ecosystems, and no sharp line can be drawn between "basic" and "applied" approaches. In general, however, the focus of the degree programs in Ecology will be on fundamental biological problems rather than on studies of a directly practical nature. The number of graduate students majoring in Geology, Anthropology, Psychology, Public Health, Education, Sociology, Architecture, and Civil Engineering are expected to find an Ecology minor useful and appropriate. Obviously, the same is true of students majoring in Zoology, Botany, Entomology Fisheries and Wildlife, and a number of other fields in the College

of Agriculture.

Behavioral Biology

The degree in Ecology would cover biological approaches to behavior and would imply that the faculty and students are trained primarily as biologists. There would be very little overlap with the graduate programs offered by the Departments of Psychology and Anthropology and the Institute for Child Development. In many ways these programs complement one another, and we have been encouraged in the development of degrees in ecology by the interest and enthusiasm of colleagues in these departments.

Research in behavioral biology has grown extremely rapidly in recent years (Fig. 1) and a large number of specialized subfields have emerged. It is no longer possible for one person to keep abreast of research in all these areas, and considerable specialization is already apparent. Interdisciplinary programs involving other fields have developed with exciting results (Fig. 2), as illustrated by the following four examples.

(1) Physiologically-oriented biologists and experimental psychologists interested in mechanisms controlling behavior have come close together in research on problems of motivation. In most cases, these questions have led to experimental work using the techniques of neurophysiologists and endocrinologists.

(2) Ethologists and comparative psychologists have converged on the topic of "imprinting" -- a rapid form of learning involved in the orientation of parental following in newly-hatched precocial birds and the orientation of sexual responses in juveniles. This is a young field with a promising future in relation to the processes of behavior development and learning.

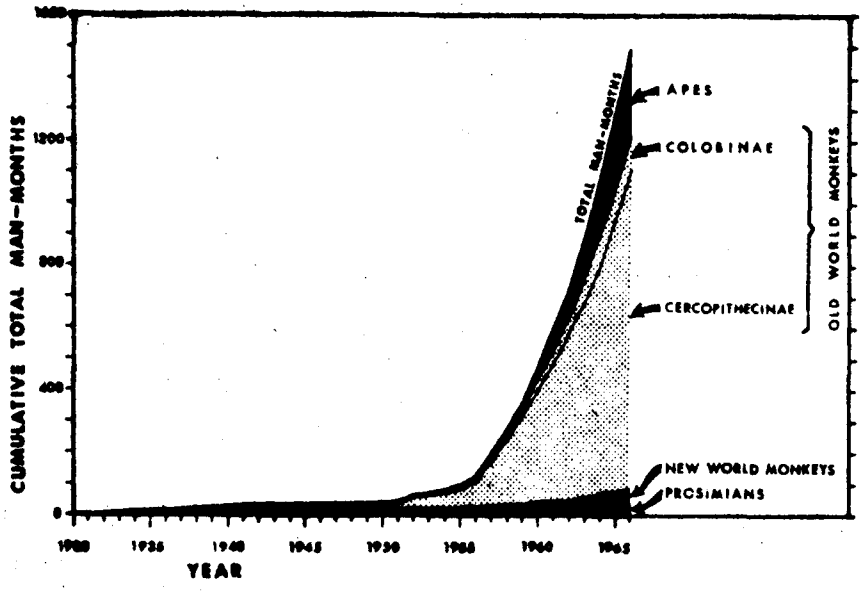

FIG. 1.—Cumulative man-months devoted to field studies of ecology and behavior of nonhuman primates (after Altmann 1966). For the purpose of this tabulation, field studies include studies in natural habitats, in artificial habitats to which animals have voluntarily adapted but to which they are not confined by barriers (for example, Indian temple monkeys), and studies on quasinatural island colonies (for example, Cayo Santiago). It does not include studies in zoos, indoor or outdoor fenced enclosures, or laboratories. It is based on results of an inquiry sent to all known primate fieldworkers early in 1965 and on reports in the literature. The results for 1965 are incomplete, hence are an underestimate.

The data indicate that the growth rate of research in this area has been fairly steady since 1955, with a doubling of actual (not cumulative) research activity every 5 years; the incomplete data for 1965 were not counted in making this calculation. Thus, the growth rate in this research area is now much faster than in scientific research as a whole, which doubles about every 15 years (Price 1963). The amount of research in this field during the period 1962 through 1965 alone was greater than all the research that preceded it!

From: Social Communication Among Primates, edited by Stuart A. Altmann, 1967, University of Chicago Press, p. xi.

	Laboratory	Field	Mixed Lab-Field, Reviews, etc.	Total
Ontogeny	7	2	-	9
Comparative	3	5	3	11
Motivation	9	-	2	10
Releasers	7	-	-	7
Social organization	3	9	3	15
Learning	8	-	-	8
Imprinting	7	-	-	7
Causal analysis	2	1	1	4
Descriptive	-	5	2	7
Evolution of behavior	5	1	2	8
Vocalizations	6	7	1	14
Olfactory recognition	5	1	1	7
Orientation to environment	6	1	2	9
Behavior genetics	5	-	1	6
Neurophysiology	10	-	2	12
Endocrinology	8	-	-	8
Techniques	2	-	-	2
Miscellaneous	1	-	1	2
	93	32	21	146

	Laboratory	Field	Review	Total
Human	5	4	6	15
Sub-human primates	5	7	3	15
Rodents	20	-	-	20
Other mammals	15	9	1	25
Chicken	9	-	-	9
Other birds	17	11	2	30
Fish	11	5	-	16
Reptiles	2	-	-	2
Amphibians	-	-	-	-
Insects	9	3	-	12
	93	39	12	144

Fig. 2. Breakdown by topics and animal groups of papers given at the XIth International Ethological Conference held at Rennes, September 2-10, 1969. Attendance at this Seventh Conference in 1961 was 171: this year the number had risen to 400. A similar rapid growth has occurred in membership of the Animal Behavior Society, now totalling over 1000. By 1968, 98 graduate schools in North America were offering programs in animal behavior.

(3) Ethologists have pioneered the application of comparative zoological methods to the study of human behavior, and an important interdisciplinary field is taking shape involving primate ethologists, anthropoligists, comparative psychologists, and sociologists. This field is in its infancy, but its potential significance is obvious. The spectacular growth in the study of primate societies under natural conditions (Fig. 1) is especially relevant here.

(4) Interest in (a) ecological adaptations (e.g. clutch-size, spacing patterns) arising from studies of population regulation and (b) behavioral adaptations (e.g. communication methods, social systems) resulting from comparative ethological studies are beginning to mesh intimately. It is now recognized that an understanding of the adaptive significance of such phenomena as territoriality, polygamy, brood-parasitism, individual variability in vocalizations, and stereotypy in signal movements can come only from a combination of ethological and ecological approaches. Analytical methods are becoming increasingly sophisticated through the use of film and tape, and experimental methods are now being applied where possible.

Much is to be gained by coupling "behavioral biology" with "ecology", as is now the case in the departmental title. In particular, it will tend to foster close liason between animal ecologists and ethologists with mutual benefits especially in the areas of population ecology and eco-ethology where already there are active programs at Minnesota. The great importance of the interrelated problems of animal movements, population regulation, spacing mechanisms, social systems, and communication phenomena has been demonstrated to the general public by such popular books as Ardrey's "Territorial Imperative" and

confirmed by the heated debates of recent years over the opposing views of Lack and Wynne-Edwards.

Behavioral biologists are convinced of the need to consider all behavioral phenomena in the light of the ecology of the species under study, and it is this orientation that characterizes the ethological approach. In view of the current trends in research to delve more and more deeply into experimental analyses of smaller and smaller problems, there is an urgent need to maintain balance by placing the small problems in the perspective of the whole animal, the species, the population, and the community.

There may come a time when it is desirable to divorce behavioral biology from ecology -- perhaps by establishing separate departments and degree programs. For the moment, the liason is welcomed by both students and faculty, and it is certain to be productive. For this reason we prefer to include "behavioral biology" under the umbrella of "Ecology" as far as the degree program is concerned. However, this arrangement will be workable only if we recognize the need to design individual graduate programs to fit the special interests of each student. To force all students into a restrictive curriculum would be disastrous and would ignore all the evidence presented here on the interdisciplinary nature of the field as it is advancing today. This will pose special problems in the planning and monitoring of student programs.

The Need for Graduate Degrees in Ecology

There is scarcely any need to draw attention to the critical need for education, research, and action on the many problems arising from the human population explosion. Basically these problems are of an ecological and behavioral nature. Earlier ripples caused by the writings of Malthus, Vogt, and others have grown, within the last few years, to a tremendous ground-swell of public concern. No biologist can deny the urgency of the crisis facing the world,

and many ecologists are now devoting most of their energy to educational and action programs with the objective of further arousing public concern. The biological basis of the problem is familiar, but it is remarkable that policies based on the fundamental facts of evolution, natural selection, population regulation, and ecosystem function have scarcely begun to be implemented in even the most "advanced" human societies. The need for graduates with advanced training in ecology and behavioral biology is urgent, and increasing demand for their services at every level is inevitable.

Graduates with M.S. and Ph.D. degrees in Ecology can be expected to take a variety of jobs. Teaching and research at the college and university level will likely be the main source of employment. Most Ph.D.'s are likely to be active researchers. This type of training is in increasing demand from industry and from federal, state, and private research and service organizations.

Well-trained biology teachers who can present the ecological point of view to students of all ages will undoubtedly be in increasing demand in the years ahead. Training at both the M.S. and Ph.D. levels is appropriate, and it seems certain that an increasing number of ecology graduates will be attracted to this field.

Trends in Research

Any brief statement on the future of research on ecological and behavioral problems is bound to be superficial. Modern methods of data collection and analysis are increasingly being used. Sampling methods and statistical techniques are being refined and mathematical models and computer programs are now widely used. More and more field problems are pursued experimentally under controlled conditions. Increasing precision in descriptive behavior studies has come with the use of electronic recording methods and with the analysis of

sounds by audiospectrographs and of movements by movie film. Team research has come to stay in many of the interdisciplinary areas, and systems analysis is applied in diverse fields. The following quotation from Robert L. Smith's book "Ecology and Field Biology" gives one ecologist's view of some current trends and interests.

> For many years ecology has been criticized for a lack of quantitative data and conceptual strength. This fault was due largely to an early concentration on purely descriptive work and an obsession for developing a new and unnecessary terminology, which (happily) is dying out. But modern ecology has shifted from description to a study of function. The day of simply listing species and describing situations in a general way is past. Now the ecologist or field biologist studies nutrient cycles, energy flow, the diversity of species, functional niches, population growth, social behavior, and so on. He draws upon chemistry, physics, and especially mathematics to develop new tools and methods to probe the ecosystem. The aquatic biologist, the marine and terrestrial ecologists, the population ecologists, and others who, walking separate ways, thought each had little in common with the other, are discovering that ecology does contain some basic concepts relevant to all.
>
> These principles gradually unfold in the chapters to follow. As yet they have not been boldly elucidated or standardized as the kind of basic laws that one finds in genetics or mathematics. In time they undoubtedly will be; but as a sort of an introduction to the material to come, some of the principles might be stated as follows.
>
> 1. The ecosystem is the major ecological unit. It has both structure and function.
> 2. The structure is related to species diversity. The more complex the structure, the greater is the diversity of species.
> 3. The function of the ecosystem is related to the flow of energy and the cycling of materials through the structural members of the ecosystem.
> 4. The relative amount of energy needed to maintain an ecosystem depends upon its structure. The more complex and mature it is, the less energy it needs to maintain one unit of that structure, or complexity (Margalef, 1963).
> 5. Ecosystems tend toward maturity; and in doing so they pass from a less complex to a more complex state. This directional change is called succession. Early stages are characterized by an excess of potential energy and relatively high energy flow per unit of biomass. In mature ecosystems, there is less waste and less accumulation of energy because the energy flows through more diverse channels.
> 6. When an ecosystem is exploited and that exploitation is maintained then the maturity of the ecosystem declines.

[illegible]

8. Relationships among populations create new functional niches, so that the accumulation of species in an ecosystem, and the increase in maturity, are to some extent self-reinforcing processes.

9. However, a functional niche within a given ecosystem cannot be simultaneously and indefinitely occupied by a self-maintaining population of more than one species.

10. Both the environment and the amount of energy fixation in any given ecosystem are limited. When a population reaches the limits imposed by the ecosystem, its numbers must stabilize or, failing this, decline (often sharply) from disease, strife, starvation, low reproduction, and so on.

11. Changes and fluctuations in the environment (exploitation and competition, among others) represent selective pressures upon the population to which it must adjust. Those organisms that cannot adjust disappear, perhaps decreasing for a time the maturity of the ecosystem.

12. The ecosystem has historical aspects. The present is related to the past, and the future is related to the present.

Today biologists seem to be gathering into two camps. In one are those who see all of biology as centered in the areas of chemistry and physics. They are drawing to them cellular physiologists, biochemists, and biophysicists. These are the molecular biologists concerned with the basic biochemical structure of life. In the other camp are the environmental biologists, who are attracting climatologists, ethologists, taxonomists, systematists, evolutionists, pedologists, and so on. In many ways this division is unfortunate, for each faction can offer much to the other. Many of the discoveries of molecular biology are relatively meaningless unless they can be viewed from the vantage point of the population and the ecosystem. And some of the problems at the population and ecosystem levels can be answered only with the help of molecular biology. In reality biology is a gradient from the molecular level to the cellular to the ecosystem, and each segment of the gradient blends into the others.

Expected Enrollment

Sixty students are currently majoring in Biology (Ecology): twenty-eight working toward the M.S. degree, thirty-two toward the Ph.D. (Appendix II). Thirty-five of these now have office space in the Museum. Unless further space becomes available it is unlikely that more than fifty graduate students can be accommodated in the Museum Building, and further expansion will depend on the development of new facilities. By 1980 the C.B.S. ten-year plan

projects a faculty numbering thirty in the Department of Ecology and Behavioral Biology (presently there are **ten**). On the basis of five graduate students for each professor this would mean that about 150 students would be advised by department members.

Five faculty members in other departments are now advising students majoring in Ecology and this number may be expected to increase substantially. Thus in total as many as 200 students may be involved by 1980.

It is difficult to predict whether the ratio of Ph.D. to M.S. students will change in the future since so many variables are involved.

Demand for admittance is expected to continue to be heavy. During the past year, seventy-seven applications for admission to the Graduate School with a major in Biology (Ecology) were processed.

The Graduate Faculty

Since the Department of Ecology and Behavioral Biology already exists, it provides the logical focal point for the degree in Ecology. At present there are nine full-time faculty members in the department. Nine other faculty members are, or will shortly be, advising students majoring in Biology (Ecology). We suggest that these seventeen professors comprise the initial graduate faculty in Ecology. (Their names and areas of research interest are given in Appendix III.)

Other faculty members who wish to advise students for degrees in Ecology will inform the Department Head, who will submit an application to the Graduate School for their appointment to the graduate faculty in Ecology. All members of the graduate faculty will be encouraged to take an active role in teaching courses, arranging seminars, evaluating applicants, arranging exams, and other duties that go along with the running of graduate studies. Thus we hope that those ecologists from departments other than the Department of Ecology and

Behavioral Biology who wish to do so will take a truly active role in administering degrees in Ecology.

Facilities and Equipment

Five members of the Department of Ecology and Behavioral Biology have office and lab space in the Bell Museum of Natural History, and there is a departmental office. Total space occupied is 1296 sq. ft. In addition, 35 graduate students majoring in Biology (Ecology) have working space in the Museum (2055 sq. ft.). Future space needs will have to be worked out with the new Museum Director in the light of the Museum's needs. Hopefully, two new staff members now being recruited can be accommodated in the building.

A request for funds to construct a new building in the vicinity of the Museum has been submitted. It is unlikely that this building will be a reality until 1974 at the earliest. Until that time physical facilities available to the department on campus will permit only limited expansion. The University and the College of Biological Sciences are committed to giving high priority to the new building.

Itasca State Park, in northern Minnesota, provides facilities for graduate training and research in a variety of habitat types. In summer, the Lake Itasca Biology Session offers a wide range of courses with ecological and behavioral emphases and there are ideal opportunities for field research experience. New winterized living quarters are now being used by graduate students conducting year-round ecological studies.

Two research facilities at Cedar Creek Natural History Area are available to students majoring in Biology (Ecology). The automatic radio-tracking system is used by many trainees studying with Drs. Tester, Siniff, and Warner supported by an NIH training grant in animal behavior. This system permits continuous

monitoring of the movements of as many as 60 wild animals (mammals, birds and fish) simultaneously and is providing data relevant to a variety of ecological and behavioral problems such as circadian rhythms, territoriality and home range, predator-prey relationships, and disease transmission. The telemetry system is largely automated, and computer programs have been developed. A full-time engineer and a programmer are employed.

The second research facility consists of three large flight-pens and six filming pens, which are being used for studies of social behavior in aquatic birds. In these covered pens wild-caught, full-winged birds can be observed and filmed under controlled conditions simulating natural habitats. Comparative and experimental studies are directed toward analyses of mate-selection, territorial spacing, and communication. Wintering facilities for birds have been developed at Carlos Avery Game Farm and on the Cedar Creek Area. A full-time animal caretaker is employed.

A live-animal room (417 sq. ft.) and an operating room (210 sq. ft.) in the Museum currently house fish and birds used in teaching animal behavior. While more animal space could be used, it is unlikely that this can be arranged within the Museum and Cedar Creek will remain the major site for extensive studies involving live animals until a new building is available.

Faculty members located in various buildings on both campuses have specialized facilities available for students they are advising in Biology (Ecology). For example, Dr. Phillips in Animal Science has a well-equipped lab suitable for a range of neurophysiological work and he also has animal holding space available to him adjacent to Peters Hall. The Limnological Research Center has laboratories fully equipped for water chemistry, algal physiology, and paleoecology.

A good working library covering many facets of ecology and behavior is being developed in the Museum. The original Museum library was primarily

ornithological in orientation but through the efforts of the full-time librarian (Mrs. Peller) and her assistant the scope has been widened considerably during the last two years. The development of this library will be supported jointly by the Museum and the Department.

Administrative Officers

The Head of the Department of Ecology and Behavioral Biology will bear final responsibility for overseeing the administration of degrees in Ecology. The Director of Graduate Studies will coordinate the reviewing of applications for admission and assistantships and will monitor the progress of all students. A committee of three (normally the director of graduate studies, the advisor concerned and one other department member) will review all student programs, petitions, etc. before they go to the Graduate School for review by the group committees.

Financial Support

Support for graduate students comes mainly from an NIH training grant and a number of research grants (Appendix IV). Six teaching assistantships are available to the Department of Ecology and Behavioral Biology. Nine new students have no assistantship support at the moment. As the Department's undergraduate teaching program expands, there will be a need for several additional teaching assistantships.

Support for faculty research and graduate student stipends is currently very good. It seems likely that the importance of basic ecological and behavioral studies will be increasingly recognized in the years ahead and federal funding for these fields seems assured. Awareness of the relevance of education in these fields is apparent at every level of society and support is likely to come also from private and business sources.

Future Faculty Needs

At the present time, recruiting is underway for a Director of Field Biology (to replace Dr. Marshall) and for a terrestrial plant ecologist whose primary responsibility would be to teach the course "Structure and function of ecosystems." If space can be found, one more faculty member will be sought in the near future, probably an ethologist with special competence in the field of bioacoustics.

Further recruiting may have to wait until the new building is available, and it would be difficult to list the sequence in which various types of ecologists might be sought at that time. All present members of the graduate faculty have ideas on the types of specialists they would like to see added. Several other departments have expressed interest in looking for specialists of various kinds who could cover fields presently not represented in the University.

Some of the possibilities may be outlined but it must be remembered that the field is changing rapidly and priorities will shift in response to the orientations of the faculty. In general, there is certain to be a need for more people to develop the systems approach and mathematical modelling. A primate or human ethologist is likely to become essential as this field continues to expand. Specialists in the areas of animal orientation and navigation, bioenergetics, radiation ecology, microbial ecology, and endocrinological aspects of behavior would be desirable.

Instruction

In view of the broad scope of ecology, course requirements for graduate degrees must be flexible. In the basic sciences, entrance requirements include a year of calculus, physics, and chemistry. Statistics is required of all graduate students, and some additional work in one of the basic sciences should be in each Ph.D. program, for example computer science or differential equations

in the mathematical field, biochemistry or some other course in chemistry, or thermodynamics or electronics in physics. Students who have additional background in the basic sciences and who have the interest and ability to apply these studies to ecological problems will be encouraged to pursue them as part of their program, at the expense of biological subjects. At least one course in some applied aspect of ecology should be included in each Ph.D. program, e.g. public health, sanitary engineering, or wildlife management, to provide a background in the practical applications of ecological studies.

There will be no language requirement for the M.S. degree. Ph.D. students will be expected to take one language only and they will not be required to have a distinct "research technique or collateral field."

Beyond these requirements the Ph.D. student must design a course program that will prepare him properly for the four fields he selects for his written preliminary examination. Because of the diverse nature of ecology, and because courses in ecology are taught in several different departments, the listing of courses in a "major" and "minor" will often be somewhat arbitrary, especially if the "minor" is the "coherent program" authorized by the Graduate School. The principal criterion for approval of the program is that it be logically related to a student's objectives and that it provide adequate preparation for his preliminary examinations. Examples of possible Ph.D. programs are given below.

In addition to formal courses, seminars are regularly scheduled to provide opportunities for semi-formal discussion of current research topics. For example, an evening seminar conducted during winter quarter by the Limnological Research Center is attended by all students and faculty working in limnology, as well as by numerous other students. A year-round evening seminar in behavior is attended by students with a major interest in this area and a

special effort is made to include speakers with diverse interests. Faculty and graduate students from Psychology and Anthropology regularly participate. Other seminars or discussion groups are arranged in plant ecology and paleoecology. The departmental seminar is conducted during the noon hour in conjunction with the Museum.

A problem of special significance in the training of ecologists and ethologists is the need to provide first-hand field experience. The difficulties are widely recognized (Appendix VI) but they are certain to increase in the future. Major problems are the great amount of time involved and the need for small classes and individual instruction. There is an especially acute danger that students will have insufficient time for field work as areas of specialization develop and the demands of course work and research in the laboratory and library increase. We are extremely fortunate in having access to two major field stations and a staff member with responsibility for field biology.

Examples of Ph.D. Programs

Example I. A student with interests and experience in working with mammals in the field for his M.S. wants to conduct Ph.D. research on the biology of foxes using telemetry techniques. In particular he wants to investigate factors influencing home range size and shape in this species as it may bear on population density. He might be advised to include the following especially relevant courses in his major:

Ecol. 116 Population dynamics
Ecol. 118 Experimental ecology
Ecol. 130 Ecology of plant communities
Ecol. 131 Structure and function of ecosystems
Ecol. 125-126 Environmental measurement
Ecol. 162 Vertebrate Ecology

Ecol. 170 Physiological Ecology
Ecol. 180 Animal Behavior
Ecol. 181 Behavioral adaptations

As a supporting field he would likely be advised to take several courses in statistics and computing (e.g. appropriate Public Health courses) or he might include such courses in his major and arrange a minor in Wildlife Management. These choices would depend on the man's orientation and his plans for future employment. Two programs of this type are shown in full in Appendix V.

Example II. A student with major interests in limnology might be advised to include the following courses in his major for the Ph.D. This student comes with a strong background in physics, chemistry and geology.

Ecol. 119 Aquatic ecology
Ecol. 127 Ecol. of soil microorganisms
Ecol. 128 Limnology
Ecol. 131 Structure and function of ecosystems
Ecol. 138 Wetland Ecology
Ecol. 139 Paleoecology
Ecol. 152 Ecology of freshwater algae
Ecol. 228 Advanced limnology
Ecol. 230 Methods for analysis of natural waters

A minor or supporting field might be arranged in various ways depending on the individual's orientation e.g. courses in public health, geology, botany, zoology, or chemistry. One example is given in Appendix V.

Example III. A student with special talents and knowledge gained through the observation of birds in the field wants to extend his M.S. work on a museum problem in avian systematics to a more ecological-behavioral topic for his Ph.D. research. He decides to investigate the social behavior and ecology of two closely related sympatric species of shorebird, focussing his attention on problems of species recognition and behavioral isolating mechanisms. He should have advanced training in systematics, evolution, ecology, and ethology, and the following courses would probably be especially relevant:

Zool. 130 Principles of systematic entomology
Zool 171 Genetics and speciation
Ecol. 130 Ecol. of plant communities
Ecol. 131 Structure and function of ecosystems
Ecol. 110 Animal behavior
Ecol. 111 Behavioral adaptations
Ecol. 136 Avian behavior
VAna. 220 Functional morphology and adaptation

His supporting program would vary according to his orientation and the strength of his earlier background. It could be heavily weighted, for example, toward statistics, systematics, zoology, or psychology.

Example IV. A student with an M.S. in physiological psychology wants to initiate a Ph.D. program in Ecology. His specific goal is an investigation of the neurophysiological basis of conflict behavior and he decides to explore brain-stimulation techniques. He has been attracted to the Ecology degree through a broad interest in biology but his background in many aspects of biology is deficient. In addition to a program of make-up courses, the following might be especially relevant:

Ecol. 170 Physiological Ecology
Ecol. 110 Animal behavior
Ec-l. 150 Behavioral physiology
Zool. 114 Sensory physiology
Zool. 283 Physiology of development
VA 201 Comparative veterinary neurology

Probably such a student would want to develop a supporting program from relevant courses in psychology.

Examples of M.S. Programs

Students aiming ultimately toward a Ph.D. will usually plan their M.S. course work with a research career in mind and will be expected to develop their competence accordingly. Students terminating with an M.S. may have need of very different course programs depending on their objectives. Many of those destined to teach ecology and animal behavior will have special need for field courses. Sample M.S. programs are included in Appendix V.

Minor in Ecology

There is likely to be considerable demand for a minor in Ecology from students majoring in other areas. The needs will vary according to the major fields e.g. Botany, Zoology, Psychology, Anthropology, Entomology Fisheries and Wildlife, Forestry, etc. Basic ecology offerings and especially the "Structure and Function of Ecosystems" course will be widely used. Initially it will be necessary to design each minor program to fit the needs of each student.

Evaluative procedures

Applications for admission to the degree program and for assistantships are reviewed by the Director of Graduate Studies and circulated to appropriate faculty members. A recommendation to admit or reject is made by the Director of Graduate Studies in consultation with the faculty members who reviewed the application. Letters of recommendation are sought and interviews are arranged in many instances when this is feasible. All other available means of evaluating the potential of applicants are used (transcripts, evaluations from previous advisers, etc.).

The Director of Graduate Studies keeps a checklist on each student from the time of admission, to indicate progress in various requirements such as prerequisite courses, examinations, etc. as well as the student's source of financial support, his honors, and other information pertinent to his graduate program. This checklist is reviewed periodically with the student or his advisor to assure normal progress and to anticipate potential difficulties. The progress of all students is reviewed at an annual faculty meeting in January.

The qualifying examination in general biology is ordinarily taken during

the first year of residence. However, if a student enters the program from some non-biological field such as chemistry, physics, or engineering because of his special competence in the physical sciences he will be expected to demonstrate a somewhat lower level of background knowledge in the major fields of biology.

The qualifying examination will be based on the subjects listed in the core curriculum. If a student has taken a course in one of these areas and has gained a grade of B or better he will be excused that section of the examination. The examination will be administered by a committee selected from the graduate faculty in ecology.

For the Plan A M.S. degree, only the final oral examination of the Graduate School is required. For the Plan B M.S. degree, a one-day written examination in ecology is given, with liberal choice (by the student) of general questions that together touch on all fields of ecology. The M.S. degree can be by-passed, on the recommendation of the adviser and the approval of the Director of Graduate Studies, if the student has a sufficiently high record in courses and if he shows promise in research.

The written preliminary examination for the Ph.D. degree consists of approximately two days of questioning in four fields of ecology and behavioral biology chosen by the student from among the following seven. The intensity of the questions and the length of time for each field depends on how the student ranks the four fields.

Population ecology
Ecosystems
Paleoecology
Limnology
Physiological ecology
Eco-ethology
Behavioral physiology

A substitution of one of these fields may be approved by the Director of

Graduate Studies if the student is prepared in another subject, e.g. radiation ecology, biogeography, microbial ecology.

Each of the seven fields of examination is represented by a committee of the Ecology faculty. In preparing for the examination, the student consults with the committee chairman to determine the scope of the field and to obtain suggestions for supplemental reading. The questions are prepared and read by at least two faculty members.

The preliminary oral examination for the Ph.D. degree is administered by the Graduate School.

After the Ph.D. student has selected his research topic, reviewed the pertinent literature, and formulated methods of approach, he presents the thesis proposal in a seminar attended by at least three members of the Ecology faculty and by interested graduate students. The purpose of the seminar is to assist the student in planning his work, and to inform the faculty of student research in its formative stage.

The final oral examination for the Ph.D. degree is administered by the Graduate School.

Courses Relevant to Ecology and Behavioral Biology

It is impossible to give a complete list of all courses which might be relevant for graduate studies in these broad areas. Many of the following are courses included in current M.S. and Ph.D. programs and they are likely to be of value to many students in the future. Because of the great diversity of possible graduate programs it is difficult to provide a meaningful list of "core courses". Obviously, offerings from the Department of Ecology and Behavioral Biology will be involved in all programs; in some cases they will constitute the main part of the program, but in other cases there could be a variety of courses from different departments. The sample programs give some indication of the courses likely to be most widely used.

An.Sci. 134	Avian Physiology
Anthro. 170	Primate and Human Evolution
Anthro. 186	Dynamics of Human Communication
Anthro. 266	Theories and problems in human ecology
Bioch.141, 142, 143	General Biochemistry
Biom. 100	Statistical Analysis I
Biom. 101	Statistical Analysis II
Bot. 126	Pre-Pleistocene Palynology
Bot. 141	Survey of Plant Physiology
Bot. 155	Freshwater algae
Bot. 165	Pollen Morphology and Taxonomy
Bot. 280	Radioisotope Techniques applied to Biology
Child Psy.184	Sensory and Motor Development
Ecol. 50	Introduction to Ecology
Ecol. 51	Ecology and Man
Ecol. 82	Field Ecology
Ecol. 110	Animal Behavior
Ecol. 111	Behavioral Adaptations
Ecol. 119	Aquatic Ecology
Ecol. 120	Advanced Limnology
Ecol. 130	Ecology of Plant Communities
Ecol. 131	Structure and Function of Ecosystems
Ecol. 133	Ecological Plant Geography
Ecol. 135	Community Structure and Function
Ecol. 136	Field Ethology
Ecol. 137	Ecological Life Histories of Plants
Ecol. 138	Wetland Ecology
Ecol. 139	Paleoecology
Ecol. 150	Behavioral Physiology
Ecol. 152	Ecology of Freshwater Algae
Ecol. 162	Vertebrate Ecology
Ecol. 163	Quantitative Ecology

Ecol. 170	Physiological Ecology of Animals
Ent. 118	Experimental Ecology
Ent. 129	Aquatic Entomology
For. 230	Forest Synecology
Fish. 151	Ecology of Fishery Populations
Wildl. 161	Wildlife Ecology and Management I
Wildl. 162	Wildlife Ecology and Management II
For. 109	Aerial Photo Interpretation
For. 143	Management of Recreational Lands
Gen. C.B. 162	Population and Quantitative Genetics
Gen. C.B. 140, 141, 142	Intermediate Genetics
Gen. C.B. 162	Population and Quantitative Genetics
Geog. 151	Climatology
Geol. 105	Introduction to Paleontology
Geol. 106	Invertebrate Paleontology
Geol. 107	Vertebrate Paleontology I
Geol. 108	Vertebrate Paleontology II
Geol. 117	Pleistocene Geology
Hydrog. 116	Glacial Geology
Hydrog. 128	Limnology
Microb. 153	Biology of Microorganisms
Pl. Path. 101	Plant Nematology
Pl. Path. 105	Introduction to the Study of Fungi
Pl. Path 132	Biology of Fungi
Pl. Path. 156	Introductory Mycology
Pl. Path. 160	Aquatic Fungi
Pl. Path. 170	Plant Sciences and the World Food Supply Problem
Pl. Path. 217	Ecology of Plant Pathogens
Psych. 127	Introduction to Behavioral Genetics
Psych. 148	Fundamentals of Physiological Psychology
Psych. 149	Neuropsychology of Motivation and Learning
Psych. 150	Perception
Psych. 151	Animal Psychology
Psych. 200	History of Psychology
Psych. 205	Introduction to Psychopharmacology
Pu. He. 110A,B,C	Biometry I
Pu. He. 111A,B,C	Biometry Laboratory I
Pu. He. 117A-B-c	Environmental Biology
Pu. He. 120D-E	Biomedical Computing
Pu. He. 233	Water Quality Investigation and Research Techniques
Pu. He. 234	Water Quality Research
Soc. 151	Comparative Social Organization
Soil Sci. 127	Ecology of Soil Microorganisms
Soil Sci. 133	Microclimatology
Soil Sci. 137	Soils and the Ecosystem
Vet. Anat. 130	Veterinary Neuroanatomy
Vet. Anat. 131	Domestic Animal Behavior
Vet. Anat. 220	Functional morphology and adaptation
Vet. Paras. 103	Diseases and Parasites of Wildlife
Zool.114	Sensory Physiology
Zool.115	Advanced Natural History of Invertebrates
Zool.117	Theoretical Biology
Zool.120	Vertebrate Structure and development
Zool.121	Ichthyology
Zool.135	Field Ornithology
Zool.171	Genetics and Speciation
Zool.271	Topics in Ecological Genetics

Appendix I

Copies of the second version of this proposal were sent to the following faculty members with the request that they circulate it for review within their departments:

Dean Sherwood O. Berg, Institute of Agriculture
Dr. William F. Hueg, Jr., Agricultural Experiment Station and Dept. of Animal Science
Dr. Landis L. Boyd, Agricultural Engineering Dept.
Dr. Herbert W. Johnson, Dept. of Agronomy and Plant Genetics
Dr. E. Adamson Hoebel, Dept. of Anthropology
Dr. LaVell M. Henderson, Dept. of Biochemistry (St. Paul)
Dean Richard S. Caldecott, College of Biological Sciences
Dr. Eville Gorham, Dept. of Botany
Dr. Harold Stevenson, Institute of Child Development
Dr. Sheldon C. Reed, Dight Institute for Human Genetics
Dean Robert J. Keller, College of Education
Dr. Alexander C. Hodson, Entomology, Fisheries and Wildlife
Dr. Richard G. Bond, Environmental Health
Dr. Frank H. Kaufert, School of Forestry
Dr. Frederick W. Forro, Jr., Dept. of Genetics and Cell Biology
Dr. John W. Webb, Dept. of Geography
Dr. Tibor Zoltae, Dept. of Geology and Geophysics
Dr. Lawrence H. Meskin, Division of Health Ecology, School of Dentistry
Dr. Leon C. Snyder, Dept. of Horticultural Science
Dr. James J. Jenkins, Center for Research in Human Learning
Dean Willard W. Cochrane, Office of International Programs
Dr. Walter J. Breckenridge, James Ford Bell Museum of Natural History
Dean E. W. Ziebarth, College of Liberal Arts
Dr. Herbert E. Wright, Limnological Research Center
Dr. Hans F. Weinberger, School of Mathematics
Dr. Robert B. Howard, College of Medical Sciences
Dr. Dennis W. Watson, Dept. of Microbiology
Dr. John P. Baldalich, Minnesota Pollution Control Agency
Dr. Milton F. Kernkamp, Dept. of Plant Pathology
Dr. Gordon T. Heistad, Psychiatry Research
Dr. John C. Darley, Dept. of Psychology
Dr. Gaylord W. Anderson, School of Public Health
Dr. Elio D. Monachesi, Dept. of Sociology
Dr. William P. Martin, Dept. of Soil Science
Dr. John T. Borchert, Center for Urban and Regional Affairs
Dr. Alvin F. Weber, Dept. of Veterinary Anatomy
Dean W. T. S. Thorp, College of Veterinary Medicine
Dr. William C. Walton, Water Resources Research Center
Dr. Magnus Olson, Dept. of Zoology

Student	Degree	Support	Major Professor
Abraham, Richard	M.S.	AEC	Dr. Mahoney
Anderson, Donna	M.S.	NSF	Dr. Wright, Jr.
Anderson, Lynne	M.S.	-	Dr. Megard
Anthony, Robert	M.S.	SSL	Dr. Wright, Jr.
Archibald, Norberg	Ph.D.	USPHS	Dr. Tester
Baker, Alan	Ph.D.	AEC	Dr. Brook
Barrett, Julie	M.S.	EDB	Dr. McKinney
Baxter, Judith	Ph.D.	Grad School Grant	Dr. Siniff
Bernborn, Donald	Ph.D.	Zool	Dr. Warner
Berg, William	M.S.	OSOI	Dr. Siniff
Bohlool, Bahrad	Ph.D.	-	Dr. Schmidt
Bruns, Dennis	M.S.	-	Dr. Megard
Burger, Joanna	Ph.D.	Zool.	Dr. Warner
Burstian, Steven	M.S.	EDB	Dr. Phillips
Byman, David	M.S.	EDB	Dr. Brook
Carlson, Robert	Ph.D.	-	Dr. Shapiro
Collingsworth, Roscoe	Ph.D.	EDB	Dr. Brook
Curtis, Steven	Ph.D.	NIH	Dr. Tester
Darling, Rudolph	Ph.D.	NSF	Dr. Brook
Field, Rebecca	M.S.	NSF	Dr. McKinney
Fisher, Weston	Ph.D.	CURA	Dr. Brook
Gilbert, James	M.S.	EDB	Dr. Erickson
Gilmer, David	Ph.D.	USPHS	Dr. Tester
Graul, Walter	Ph.D.	NIH	Dr. McKinney
Grissanti, Nikki	M.S.	-	Dr. Erickson
Hatch, Sandra	M.S.	-	Dr. Chiang
Hessler, Edward	Ph.D.	NIH	Dr. Siniff
Hofman, Robert	Ph.D.	NSF	Dr. Erickson
Houseknecht, Clyde	Ph.D.	USPHS	Dr. Tester
Jacobson, George	M.S.	-	Dr. Brook
Johnson, Kenrick	M.S.	Ext. Div.	Dr. Megard
Joyce, John	Ph.D.	LRC	Dr. Brook
Kalin, Oscar	Ph.D.	NSF	Dr. Erickson
Kaufman, Gerald	Ph.D.	-	Dr. McKinney
Klemer, Andrew	Ph.D.	AEC	Dr. Brook
Koivuniemi, Liisa	Ph.D.	-	Dr. Wright, Jr.
Lamarra, Vincent	M.S.	EDB	Dr. Shapiro
Lewis, Mary	M.S.	NSF	Dr. Wright, Jr.
Mace, Terrence	M.S.	-	Dr. Phillips
Magraw, Susan	M.S.	-	Dr. Wright, Jr.
Mock, Douglas	M.S.	-	Dr. McKinney
Montgomery, Gerald	Ph.D.	NIH	Dr. Siniff
Nicholls, Thomas	Ph.D.	-	Dr. Warner
Nichols, Rosemary	M.S.	-	Dr. Megard
Olson, James	M.S.	-	Dr. Siniff
Rogers, Lynn	M.S.	Big Game Club	Dr. Erickson
Sams, Lawrence	M.S.	-	Dr. Megard
Saunders, Donald	Ph.D.	AEC	Dr. McKinney
Smith, Paul	M.S.	MSPCA, LRC	Dr. Brook
Stark, Donna	Ph.D.	AEC	Dr. Wright, Jr.
Storm, Gerald	Ph.D.	NIH	Dr. Siniff
Sturm, Michael	M.S.	-	Dr. Megard

Terrapchak, Stephan	Ph.D.	[illegible]	Dr. **Shapiro**
Thomas, William	Ph.D.	-	Dr. Erickson
Thorkelson, Jeffery	Ph.D.	USPHS	Dr. Tester
Thornton, Kent	Ph.D.	-	Dr. Megard
Tweeton, Jacqueline	M.A.	Animal Science	Dr. Phillips
VanRyzin, Mary Paul	M.S.	EBB	Dr. Chiang
Watkins, Paul	Ph.D.	-	Dr. Wright, Jr.
Yenko, James	Ph.D.	CURA	Dr. Shapiro

AEC: Atomic Energy Commission
CURA: Center for Urban & Regional Affairs
EBB: Ecology & Behavioral Biology
FWPCA: Federal Water Pollution Control Administration
LRC: Limnological Research Center
NIH: National Institute of Health
NSF: National Science Foundation
USDI: U.S. Dept. of Interior
USPHS: U.S. Public Health Service

The following faculty, [illegible] is associated with the development of a graduate [illegible] Biology. Members of the faculty who have already expressed a desire to advise or are already advising students majoring in Biology.

Bakuzis, Egulfs V., Ph.D. (Minnesota, 1962). Associate Professor. Forest Syncology.

*Bright, Robert C., Ph.D. (Minnesota, 1963). Associate Professor. Paleoecology, palynology.

*Brook, Alan J., Ph.D. (Durham, 1965). Professor. Freshwater algal ecology.

Cheng, Huai C., Ph.D. (Minnesota, 1963). Professor. Insect ecology.

Cushing, Edward J., Ph.D. (Minnesota, 1963). Associate Professor. Palynology, paleoecology.

Erickson, Albert W., Ph.D. (Michigan State, 1964). Associate Professor. Mammalian ecology.

Gorham, Eville, Ph.D. (London, 1951). Professor. Limnology, wetland ecology, biogeochemistry.

Lawrence, Donald B., Ph.D. (Johns Hopkins, 1936). Professor. Ecosystem development.

*Marshall, William H., Ph.D. (Michigan, 1942). Professor. Vertebrate ecology.

*Maxwell, Robert K., Ph.D. (Minnesota, 1969). Assistant Professor.

*McKinney, Frank D., Ph.D. (Bristol, 1953). Associate Professor. Animal behavior.

*Megard, Robert O., Ph.D. (Indiana, 1962). Assistant Professor. Paleolimnology, zooplankton ecology, production limnology.

Phillips, Richard E. Ph.D. (Cornell, 1959). Associate Professor. Physiology and behavior.

Schmid, William D., Ph.D. (Minnesota, 1960). Associate Professor. Physiological ecology of vertebrates.

Schmidt, Edwin L. Ph.D. (Rutgers, 1949). Professor. Ecology of soil microorganisms.

*Shapiro, Joseph. Ph.D. (Yale, 1957). Associate Professor. Limnology.

*Sniff, Donald B., Ph.D. (Minnesota, 1957). Assistant Professor. Biomathematics, animal behavior.

*Tester, John R., Ph.D. (Minnesota, 1960). Associate Professor. Vertebrate radiation ecology, biotelemetry.

Underhill, James C., Ph.D. (Minnesota, 1955). Professor. Fish and aquatic invertebrate ecology.

Warner, Irwin W., Ph.D. (Cornell, 1947). Associate Professor. Avian and mammalian ecology, biotelemetry.

Williams, Frederick G., Ph.D. (Yale, 1959). Associate Professor. Theoretical and experimental population dynamics.

*Wright, Herbert E., Jr., Ph.D. (Harvard, 1943). Professor. Paleoecology.

+ Member of Dept. of Ecol. + Beh. Biol.

Appendix IV

Faculty Research Grants

On ecological studies of the Dynamics of planktonic blue green algae, with special reference to their microstratification. AEC. Principal Investigator: Alan J. Brook.

The effects of water flow and water temperatures on populations of attached algae in springs, streams and rivers. Principal Investigator: Alan J. Brook.

Research studies on the moose population on Agassiz Refuge utilizing biotelemetry. U.S. Dept. of Interior, Bureau of Sport Fishereis and Wildlife. Principal Investigator: Donald B. Siniff.

Population Dynamics of Antarctic Seals. This research is a five-year study on the status of the leopard, crabeater, Ross and Weddell seal of Antarctica. Principal Investigator: Donald B. Siniff.

Development of equipment and methods in the fields of biotelemetry and data analysis for waterfowl research. U.S. Dept. of the Interior, Bureau of Sport Fisheries and Wildlife. Principal Investigators: Donald B. Siniff and John R. Tester.

To determine and evaluate the influence of environment on vertebrate behavior in natural ecosystems through use of recently developed techniques such as biotelemetry and radionuclide tagging. Biomathematical approaches such as model construction and systems analysis are being developed to investigate situations in which many interrelated environmental factors function in an integrated manner on individual organisms and populations. NIH. Program Director: John R. Tester. Also involved are Donald B. Siniff and Frank McKinney.

Effects of ionizing radiation and other environmental factors on breeding behavior, activity patterns and movement of selected vertebrates. AEC. John R. Tester, Principal Investigator, and Frank McKinney, Donald B. Siniff.

Fixed action patterns and their role in communication. USPHS. Principal Investigators: Frank McKinney and Richard E. Phillips.

An environmental measuring system for micrometeorological data to determine how habitats effect weather components and the physical relationship between environmental parameters and an organism within the habitat. Principal Investigator: Robert K. Maxwell.

Population dynamics and movements of five species of squirrels in the Itasca Biology Station. NSF. Principal Investigator: William H. Marshall.

Water quality, organic productivity and the distribution of organisms in Minn. lakes. USDI. Principal Investigator: Robert O. Megard.

Effect of sewage effluents. USDI. Principal Investigator: Robert O. Megard.

Study of Lake Minnetonka. Hurza. Engr. Principal Investigator: R. O. Megard.

Relation of phosphorus in lake bottom deposits and pollutional history of Minnesota lakes. USDI. Principal Investigator: Joseph Shapiro.

Community analysis in the littoral zone of lakes. FWPCA. Principal Investigator: Herbert E. Wright, Jr.

Lake quaternary environmental history beyond the glacial border. NSF. Principal Investigator: Herbert E. Wright, Jr.

The late Wisconsin landscape in the Minnesota area. NSF. Principal Investigator: Herbert E. Wright, Jr.

Coherent area program in limnology. NSF. Principal Investigator: Herbert E. Wright, Jr.

Diatoms in lakes and lake sediments as an index to environment. AEC. Principal Investigator: Herbert E. Wright, Jr.

2 4 2 4 0 3

[redacted] DAVID SEELEY

UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

WHITE – GRADUATE SCHOOL
PINK – DATA PROCESSING
CANARY – ADVISER/DEPT

PH. D. PROGRAM & LANGUAGE DECLARATION
A CURRENT GRADE TRANSCRIPT MUST BE ATTACHED

NAME (LAST)	(FIRST)	(MAIDEN)	(MIDDLE)	GRAD. NUMBER
[redacted]			Seeley	135180

MAIL ADDRESS (STREET) (CITY) (STATE)	(ZIP CODE)	PHONE NUMBER
1309 Talmadge Avenue S.E., Minneapolis, Minnesota	55414	331-7102

GRAD 1 31 69	MAJOR	MINOR (OR SUPPORTING FIELD)
	(Ecology) Biology	Wildlife Management

LANGUAGE REQUIREMENT (CHECK OPTION)

____ 1. HIGHER PROFICIENCY IN ONE LANGUAGE: ____

____ 2. PROFICIENCY IN TWO LANGUAGES: ____ AND ____

____ 3. PROFICIENCY IN ONE LANGUAGE: ____ AND THE FOLLOWING SPECIAL RESEARCH TECHNIQUE: ____

X 4. PROFICIENCY IN ONE LANGUAGE: French AND THE FOLLOWING COLLATERAL FIELD OF KNOWLEDGE: Biometry

DEPT.	COURSE NO.	TITLE	INSTRUCTOR	CREDITS	GRADE	REMARKS
		MAJOR COURSES		TOTAL CREDITS:		
[redacted]t	422	Systematics	Wagner	4	B	U of Mich
Bot	425	Phytogeography	Benninghoff	3	A	U of Mich
[redacted]r	408	Hydrology	Cooper	2	A	U of Mich
[redacted]	478	Nat. Res. Economics	Gregory	3	B	U of Mich
For	431	Entomology	Knight	3	A	U of Mich
W & F	443	Limnology	Saunders	3	B	U of Mich
[redacted]ol	400	Ornithology	Tordoff	4	A	U of Mich
Zool	472	Animal Geography	Burt/Miller	3	A	U of Mich
For	493	Silviculture	Barnes	4	A	U of Mich
[redacted]o	413	Photo. Interpretation	Olson	3	A	U of Mich
For	421	Fire Control and Use	Davis	3	A	U of Mich
Ecol	130	Communities	Cushing	5	A	U of Minn
[redacted]l	110	Animal Behavior	McKinney	3	A	U of Minn
[redacted]ol	111	Behavioral Adaptations	McKinney	3		U of Minn
Ecol	299	Telemetry Programming	Tester/Siniff	2		U of Minn
[redacted]ol	171	Genetics & Speciation	Merrell	3		U of Minn
[redacted]ol	131	Structures & Function of Ecosystems	Bray/Cushing	5		U of Minn
		MINOR OR SUPPORTING FIELD COURSES		TOTAL CREDITS:		
W & F	429	Foundations of Wildlife Management	Chase	3	A	U of Mich
[redacted] F	435	Field & Lab. Tech.	Hunt	3	A	U of Mich
[redacted] F	436	Life Histories of Game Animals	Hunt	3	A	U of Mich
[redacted] F	438	Diseases of Wildlife	Cowan	3	A	U of Mich
[redacted] F	439	Waterfowl Management	Hunt	2	A	U of Mich
Ent	276	Wildlife Management: Big Game	Mackie	4		U of Minn
		RESEARCH TECHNIQUE OR COLLATERAL FIELD		TOTAL CREDITS:		
[redacted]	408	Intro. Biometry	Smith	3	A	U of Mich
[redacted]	110/111A	Biometry I	Bartsch	5	A/B	U of Minn
[redacted]	110/111B	Biometry II	Bartsch	5		U of Minn
Biost	120A	Biomedical Computer	Rogue	3	A	U of Minn
[redacted]	123	Topics in Biometry	Jaffries	3		U of Minn

THIS PORTION NOT TO BE FILLED IN BY STUDENT

MAJOR ADVISER'S SIGNATURE

MINOR ADVISER'S SIGNATURE

PRELIM. ORAL EXAM COMMITTEE

J. Tester, ch.
D. Siniff
C. Cushing
Wm Marshall
J. Shapiro

GROUP COMMITTEE ACTION:
☑ APPROVED ☐ DISAPPROVED

CHAIRMAN DATE

GRADUATE SCHOOL ACTION:
☑ APPROVED ☐ DISAPPROVED

DEAN DATE

PRELIM. ORAL EXAMINATION CHECK LIST

DATE ____

LANG. REQUIREMENT ____

PRELIMINARY WRITTEN ____

MINOR COURSE REQUIREMENT ____

MAJOR COURSE REQUIREMENT ____

[redacted] 65 (REV. 8/67) (0)

(LAST)	(FIRST)	(MAIDEN)	(MIDDLE)	GRAD. NUMBER
Ecker	Alex		Lee	118540

PRESENT ADDRESS (STREET)	(CITY)	(STATE)	(ZIP CODE)	PHONE NUMBER
1756 Grand Avenue	St. Paul	Minnesota	55105	690-2184

MAJOR	MINOR (OR SUPPORTING FIELD)
Biology -- Ecology	Geology

LANGUAGE REQUIREMENT (CHECK OPTION)

_____ 1. HIGHER PROFICIENCY IN ONE LANGUAGE: _____

X 2. PROFICIENCY IN TWO LANGUAGES: German AND French

_____ 3. PROFICIENCY IN ONE LANGUAGE: _____ AND THE FOLLOWING SPECIAL RESEARCH TECHNIQUE: _____

_____ 4. PROFICIENCY IN ONE LANGUAGE: _____ AND THE FOLLOWING COLLATERAL FIELD OF KNOWLEDGE: _____

THIS PORTION NOT TO BE FILLED IN BY STUDE

MAJOR ADVISER'S SIGNATURE

MINOR ADVISER'S SIGNATURE

PRELIM. ORAL EXAM COMMITTEE

DEPT.	COURSE NO.	TITLE	INSTRUCTOR	CREDITS	GRADE	REMARKS
MAJOR COURSES				TOTAL CREDITS: 58		
Bot.	131	Struc., Func. Ecosys.	Rainers	5	A	
Bot.	133	Boreal Forests	Cairns	3	B	
Bot.	141	Survey, Plant Physiol	Krenkel	3	A	
Bot.	151	Biology of Algae	Brook	5	B	
Bot.	152	Ecology of Algae	Brook	5	A	
Zool.	120	Advanced Limnology	Hergard	5		
Zool.	135	Struc., Func. Commun.	Frey, Tester	- 5	-	
Ecol.	299	Research Problems	Brook	6	A	
"	"	" "	"	6	A	
"	"	" "	"	5	A	
"	"	" "	"	5	A	
"	"	" "	"	5	A	
"	"	" "	"	5	A	
Zool.	119	Limnology	Underhill	5	A	
MINOR OR SUPPORTING FIELD COURSES				TOTAL CREDITS: 22		
Geol.	116	Glacial Geology	Wright	3	A	
Geol.	117	Pleistocene Geology	Wright	3		
Geol.	128	Limnology	Shapiro	4	B	
Geol.	230	Meth. Anal. Nat. Wat.	Shapiro	3	S	
Geol.	216	Seminar -- Limnology	Wright	1	S	
Geol.	216	Seminar -- Pleisto.	Wright	1		
Geol.	229	Research Problem	Shapiro	2		
Ecol.	139	Paleoecology	Cushing	5		
RESEARCH TECHNIQUE OR COLLATERAL FIELD				TOTAL CREDITS 8		
Pub. H	110	Biol. Statistics I	Bartsch	3	B	
Pub. H	111	" " (lab)	Bartsch	2	B	
Pub. H	120	" " II	Bartsch	3	B	

GROUP COMMITTEE ACTION:

☐ APPROVED ☐ DISAPPROVED

CHAIRMAN _____ DATE

GRADUATE SCHOOL ACTION:

☐ APPROVED ☐ DISAPPROVED

DEAN _____ DATE

PRELIM. ORAL EXAMINATION CHECK LIST

DATE _____

LANG. REQUIREMENT _____

PRELIMINARY WRITTEN _____

MINOR COURSE REQUIREMENT _____

MAJOR COURSE REQUIREMENT _____

S. 65 (REV. 4 67) ()

[redacted] 30509 HOUSEKNECHT CLYDE RICH

TYPE OR PRINT – NO CARBON REQUIRED – DO NOT SEPARATE THESE SHEETS

UNIVERSITY OF MINNESOTA
GRADUATE SCHOOL

WHITE – GRADUATE SCHOOL
PINK – DATA PROCESSING
CANARY – ADVISER/DEPT.

PH. D. PROGRAM & LANGUAGE DECLARATION
A CURRENT GRADE TRANSCRIPT MUST BE ATTACHED

NAME (LAST)	(FIRST)	(MAIDEN)	(MIDDLE)	GRAD. NUMBER
Houseknecht	Clyde		Richard	135091

LOCAL ADDRESS (STREET)	(CITY)	(STATE)	(ZIP CODE)	PHONE NUMBER
GRAD 305 Cedar Creek Natural History Area	Bethel	Minnesota	55005	434-5131

	MAJOR	MINOR (OR SUPPORTING FIELD)
	Biology (Ecology)	Wildlife Management

LANGUAGE REQUIREMENT (CHECK OPTION)

[ ] 1. HIGHER PROFICIENCY IN ONE LANGUAGE: _____

[ ] 2. PROFICIENCY IN TWO LANGUAGES: _____ AND _____

[X] 3. PROFICIENCY IN ONE LANGUAGE: Spanish AND THE FOLLOWING SPECIAL RESEARCH TECHNIQUE: Computer Programming

[ ] 4. PROFICIENCY IN ONE LANGUAGE: _____, AND THE FOLLOWING COLLATERAL FIELD OF KNOWLEDGE: _____

THIS PORTION NOT TO BE FILLED IN BY STUDENT

MAJOR ADVISER'S SIGNATURE

MINOR ADVISER'S SIGNATURE

PRELIM. ORAL EXAM COMMITTEE

J. Tester, Chm.
E. Cushing
D. Lawrence
D. Williams
W. Schmid

MAJOR COURSES — TOTAL CREDITS: 50.0

DEPT.	COURSE NO.	TITLE	INSTRUCTOR	CREDITS	GRADE	REMARKS
Zool.	450	Ichthyology	Cooper	4.5	A	P.S.U.
PathSci	420	General Animal Path	Dunn	4.5	A	P.S.U.
Zool.	439	General Animal Ecology	Sellis	4.5	A	P.S.U.
Bot.	414	Plant Taxonomy	Wall	4.5	B	P.S.U.
Zool.	401	Animal Behavior	Hale	4.5	B	P.S.U.
Zool.	198	Marine Biology	Kingsbury	3.5	S	Cornell
Ecol.	158	Environmental Measurement	Miller	5	P	
Ecol.	150	Plant Communities	Cushing	5	P	
Ecol.	298	Prod. Terr. Ecosystems	Cushing	1	S	
Biol.	171	Genetics and Speciation	Harrell	3	B	
Biom.	100	Statistical Analysis I	Keenan	4	B	
Biom.	101	Statistical Analysis II	Keenan	4	B	
Ent.	118	Experimental Ecology	Chiang	3		
Ecol.	137	Ecol. Life Hist. Plants	Lawrence	5		
Zool.	109	General Endocrinology	Sullivan	3		

MINOR OR SUPPORTING FIELD COURSES — TOTAL CREDITS: 19.5

Zool.	509	Wildlife Mgmt. Tech.	Davis	3	A	P.S.U.
Zool.	546	Animal Populations	Davis	4.5	B	P.S.U.
For.	270	Big Game Management	Mackie	4	S	
Ent.	194	Big Game Management Sem.	Mackie	1	A	
For.	178	Wildlife Administration	Mackie	4		
For.	194	Adv. Wildlife Biology	Tester	3		

RESEARCH TECHNIQUE OR COLLATERAL FIELD — TOTAL CREDITS: 9.5

Desc	502	Desc & Disc Tpts Apltn	Fernitt	4.5	A	P.S.U.
Biom	120A	Biomedical Computing	Pogue	3		
Zool.	299	Special Topics in Ecology	Siniff	7		

GROUP COMMITTEE ACTION:
[X] APPROVED [ ] DISAPPROVED
CHAIRMAN _____ DATE _____

GRADUATE SCHOOL ACTION:
[X] APPROVED [ ] DISAPPROVED
DEAN _____ DATE 3/1

PRELIM. ORAL EXAMINATION CHECK LIST

DATE _____

LANG. REQUIREMENT _____

PRELIMINARY WRITTEN _____

MINOR COURSE REQUIREMENT _____

MAJOR COURSE REQUIREMENT _____

G.S. 85 (REV. 8/67) (1)

UNIVERSITY OF MINNESOTA
GRADUATE SCHOOL

Master's Degree Program

Smith, Paul Dennis 135219
2321 30th Ave. S., Mpls., Minn. 55406
729-7648

Graduate of: Augsburg College, B.A. 1967

U. of M. Entrance Date: Sept. 1967

Degree Sought: M.S., Plan A

Major: Ecology
Minor: Biochemistry

Language: German
Grad. Credits Completed: 34

Major Courses	Instructor	Total Credits in Major: 23 Credit	Grade
Bot. 155 Freshwater Algae	Brook	5	A
Ecol. 196 Prob. in Ecology	Brook	5	A
Ecol. 152 Ecol. of Algae	Brook	5	A
Ecol. 196 Prob. in Ecology	Brook	5	A
Ecol. 230 Anal. of Nat. Water	Shapiro	3	

Plan A Students - Thesis Title: "Studies of the effects of sewage effluents on phytoplankton productivity in experimental ponds."

Minor or Related Field Courses	Instructor	Total Credits in Minor: 19 Credit	Grade
Bioch. 141 Gen. Biochem.	Kirkwood	3	B
Bioch. 142 Gen. Biochem.	Wold	3	
Bioch. 143 Gen. Biochem.	Gander	3	
Biom. 100 Statistical Anal.	Hicks	5	A
Biom. 101 Statistical Anal.	Mann	5	

Adviser: Alan J. Brook

Examining or Thesis Committee: A. J. Brook
J. Shapiro
J.S. Anderson

Appendix VI

ECOLOGY

Vol. 50 LATE SPRING 1969 No. 3

COMMENTARY

The Ecologists' Telescope

Graduate education in ecology faces a dilemma. On the one hand, a university is supposed to be a community of interacting scholars. For this reason, faculty and students have normally been required to make the university their headquarters and most courses are taught there. On the other hand, graduate training should have some of the spirit of apprenticeship, with students learning and modifying the scientific methods they see their teachers using. At the very least, since the Ph.D. is a certificate of research ability, the student should spend most of his time in an atmosphere of research. In most scientific fields, these requirements are perfectly compatible; the physicist or biochemist can best do his research in the laboratory and the student not only is an apprentice but also benefits from the community of scholars, the library, and so forth. But much of modern ecology has to be done in the field and should be taught there. If they are required to spend their time on campus, ecology faculty and students cannot be doing much research. At the most the student can spend only the summer months learning by apprenticeship and can hope to spend other months in his later graduate years alone in the field.

The dilemma is not quite unique to ecology and not all students suffer equally. Astronomers of universities in smoggy cities have long had special privileges and run much of their training at observatories remote from their home institution. But the lesson of the astronomers has not been seized by ecologists. Even where winters are warm and a diversity of nearby habitats is available, ecology is taught in large classrooms with only an occasional inadequate field trip. A very few students are lucky enough to spend a few months at Organization for Tropical Studies courses in Costa Rica and many more take a summer course at Woods Hole or Friday Harbor, but this is just a drop in the bucket. Most ecology students spend nine months pacing the floors of their home institution—or if they are lucky, commuting to the field from it as classes permit—and three months living in the field. And the faculty have only those three months to look forward to.

What is the cure? Some sort of field station seems to be the answer. A field station with enough resident faculty to offer a respectable semester of courses (not only in ecology—also geology, meteorology, etc.) open to undergraduates. In the other semester and during the summer the faculty could devote more of their time to their own research and to graduate teaching. Although a national institute of ecology has been urged on other grounds,[1] it could not handle the necessary number of students and faculty. Rather, separate stations, perhaps even one per university, are needed, although permission for students of one university to study at another's station should be routine in most cases.

What about the universities which are thus deprived of ecologists just when the importance of ecology is being recognized? This problem will probably cure itself; by no means all ecologists will favor such field stations and, as long as they aren't made to feel inferior by staying behind, will keep ecology one of the components of the community of scholars.

This has been written as if all institutions should move their ecology programs into the field. Of course not all ecologists will—or should—agree and not all institutions will—or should—become involved. But enough field training programs should exist to handle the students and faculty who would prefer them.

Robert MacArthur
Princeton University

[1] R. H. Whittaker's "Commentary" in *Ecology* 50(2).