# UNIVERSITY OF MINNESOTA
## Graduate School

Minutes, Graduate School Executive Committee
Meeting of Thursday, October 11, 1984
1:30 p.m., 303 Johnston Hall

Present: Faculty representatives--Professors James R. Boen, J. Vernon Jensen (for Jerome Hammond), Dale L. Lange, Edward I. Sucoff, David R. Thompson; administrative representatives--Deans Robert T. Holt (Chair), Judson D. Sheridan, Kenneth Zimmerman; student representatives-- Beth D. Caplan (for Kevin Anderson), Patrick G. Coin, Debra J. Herreid, Stephen Linne; Graduate Fellowship Committee representative--Gary R. Gray; Civil Service representative--Karen Starry; staff--Stephen C. Hedman, Andrew J. Hein, Myrna Smith; secretary--Vicki Field

Committee members introduced themselves. Dean Holt expressed his concern over the high percentage of Policy and Review Council chairs whose terms will expire after this academic year. To avoid a large turnover in Council chairs in 1985-86 and to thus ensure continuity on the Graduate School Executive Committee, he has asked the Social Sciences and the Physical Sciences Policy and Review Councils to elect new chairs this fall, Dean Holt reported. He thanked Professors Hammond and Thompson for their exemplary service on the Executive Committee and for their excellent contributions over the past several years.

I. **FOR ACTION**

A. Approval of the Minutes of the June 4, 1984 Meeting

The minutes were approved as submitted.

B. Proposed Criteria Governing Continued Graduate Faculty Membership for Professors Emeriti

Professor Thompson explained that this issue had arisen in the Physical Sciences Policy and Review Council, and he expressed satisfaction with the revised draft of the statement. Discussion ensued in which it was suggested that the proposed mechanism for continuing a graduate faculty appointment was too cumbersome and perhaps degrading to a faculty member of long-standing at the University. Committee members agreed to further amend the statement as follows (added material is underscored; deletions are crossed out):

> Page 1, para. 2, line 2: "Application shall be by the faculty member through the Director of Graduate Studies of the program in which continued graduate faculty membership is desired, <u>or by nomination from a member of the graduate faculty in the same program with the nominee's consent.</u>"

Page 1, para. 2, line 4: "The nomination shall be accompanied by a letter from the nominee ~~requesting continued membership in the graduate faculty and~~ stating that he or she agrees to accept the range of responsibilities associated with a particular rank, including the obligation to meet with graduate students on a regular basis during the period of continued appointment."

Page 2, last para., line 1: "Because the University does not encourage reliance on retired faculty for classroom teaching, involvement of emeritus professors in the activities of graduate programs should primarily concern advising of graduate students, service on examining committees, and limited participation in graduate courses, ~~but not as the principal course instructor~~."

Executive Committee members voted to approve the criteria as amended with a delayed implementation date of January 1, 1985 to give the Policy and Review Councils an opportunity to discuss the statement and raise any objections they might have. (Copy of proposed criteria attached with these minutes)

## II. FOR DISCUSSION

A. Report of the Task Force on the Quality of Graduate Education and Research
B. Work-Study Financial Aid for Graduate Students
C. Institutional Planning
D. An Accounting Model Versus an Economic Model in Determining Instructional Cost

(Dean Holt addressed items B.-D. as part of his presentation of the Task Force report, since all of these issues are either mentioned in the report or bear significantly on it.)

Dean Holt called attention to the charge to the Task Force cited at the beginning of the report, and he stressed the relationship of graduate education and research to area growth and to a strong undergraduate program. Successful development of the University over the next decade as a national research university, a land-grant institution, and an urban public university will depend on strengthening the University's research and graduate components, he said.

Dean Holt identified three major sections of the report, which concern strengthening of the faculty, strengthening of the graduate student population, and improving central facilities. Because many of the recommendations contained in these three sections do not fall within the Graduate School's jurisdiction, the Graduate School and graduate faculty must participate in University planning if the recommendations are to be successfully implemented. (A fourth section of the report deals with program reviews and largely reflects the process already followed in the second review cycle.)

In an extensive presentation, Dean Holt reviewed key recommendations in each of the three principal sections of the report and addressed the Graduate School's responsibilities with respect to the quality of the graduate faculty, students, and programs. He reported that President Magrath recently cited as an institutional goal the doubling of top-ranked graduate programs (those with a composite score of 60 or more in the national rankings) by 1992. This would mean that 26, rather than the present 13, graduate programs would be highly ranked, making the University of Minnesota one of the highest- rated public institutions in the country, second only to the University of California at Berkeley. Care must be taken in an effort to improve program quality to strengthen program areas (rather than individual programs) and to also develop graduate programs that are not accounted for in the national ranking system, Dean Holt emphasized.

With regard to attracting and retaining top-quality graduate students, Dean Holt stressed the need to lower Minnesota's high ratio of undergraduate to graduate students and to significantly increase graduate student support. The Regents' resolution last spring to stabilize Graduate School tuition over the next several years will give the University a competitive advantage in recruiting graduate students, he added. Concerning student financial aid, Dean Holt reported that the University's biennial budget request will contain a request for an additional $2.5 million for graduate student support; if the legislature approves the request, the University has agreed to provide an equal amount, resulting in a $5 million increase in graduate student aid which would be used to fund a tuition fellowship program as proposed by the Gassman Committee and discussed by the Executive Committee and the Policy and Review Councils last year. Dean Holt briefly reviewed key features of the Gassman Committee recommendations and described details of a plan to adopt a University policy of awarding tuition fellowships to all research assistants. The University Senate Committee on Research will consider such a policy this fall; if adopted, the policy would allow the University to renegotiate its overhead rate on federal grants and contracts. An increase of 1.5 to 2 percent in the current overhead rate would provide funding for tuition fellowships for externally sponsored RA's, freeing part of the anticipated $5 milion for support of qualified graduate students who do not hold a graduate assistantship. Dean Holt mentioned that there is strong support both within and outside the University for increased financial aid for graduate students, and he was optimistic that an additional $6 million would be available by fall 1987.

Dean Holt commented on implications for graduate education of the reauthorization of the Higher Education Act (which authorizes the Guaranteed Student Loan, GPOP, and work-study programs, among others) and described in detail two bills pending in the U.S. House of Representatives, one introduced by Missouri Congressman Thomas E. Coleman for a total of $150 million and the other by Michigan Congressman William D. Ford in the amount of $400 million. Dean Holt believed that some form of the two bills will be incorporated into the reauthorization of the Higher Education Act; if so, the federal government will assume a new role in graduate education in the U.S., he said. Because these bills also contain a stipulation that graduate students are financially independent for tax purposes at the time they enroll in a graduate program, the bills, if adopted, would expand use of college work-study funds for graduate students. (Although these federal funds have been available to financially needy graduate as well as undergraduate students since their original authorization, they have traditionally been used to support undergraduates.) Dean Holt emphasized the impact a large amount of additional work-study funding would have on support of graduate students here, and he explained at length how appointment of graduate assistants on work-study funds might work and commented generally on the advantages of this funding arrangement. As a member of the Association of American Universities Working Group on Federal Legislation he is trying to generate support both on the state and national levels for the Coleman and Ford bills, Dean Holt reported. Concern was expressed by several student members of the Executive Committee that increased graduate student aid obtained on the basis of financial need could not be distributed on a merit basis.

With respect to efforts to strengthen the graduate faculty, Dean Holt said the Graduate School is making a major effort to increase both its general research and start-up funds, and to better organize the latter. A proposal, which is still pending, has been made to a local foundation for $3.5 million to establish a program of junior faculty fellowships. Dean Holt elaborated on this program, as described in the Task Force report. At the senior faculty level, a proposal will be made to the legislature that the University use its permanent endowment fund--currently at $54 million--to create approximately 70 endowed chairs across all disciplines of the University.

Regarding an accounting model versus an economic model to determine instructional cost, an issue considered by the Executive Committee last year in its deliberations concerning Graduate School tuition, Dean Holt stated that discussions with MPIS continue about a model that will reflect not only the expense but also the benefits of graduate education to the University. Whether a change is made in the way the University calculates instructional cost will depend on the new University president when this individual is appointed, however.

Dean Holt said he would like to have Policy and Review Council members familiarize themselves with the thrust and recommendations of the Task Force report and to consider particularly whether any important items have been omitted. Discussion of the report by the Councils and Executive Committee will continue over the course of the academic year.

Dean Holt stressed the need to improve the visibility of the Graduate School and graduate education; to this end, he has created an advisory committee to the Graduate School whose membership includes area business leaders. Professor Sucoff agreed that widespread support for initiatives to improve graduate education and research is important, since all programs will benefit, although some will benefit perhaps more than others. He questioned the role of the job market in efforts to strengthen graduate programs, however. Dean Holt stated that in fields such as science and technology, in which the job market is excellent, graduate education must be made sufficiently attractive to encourage undergraduates to pursue graduate studies and to thus ensure future generations of scholars and researchers. The humanities, where the job market is poor, have experienced a significant decline in graduate student quality; this has severe implications for teaching at the university level in a number of years and is a matter of national concern. These areas must also be improved to attract high caliber graduate students and thereby guarantee future generations of scholars. (Copy of Task Force Report attached with these minutes)

E. Graduate School Student Conduct Code

Dean Zimmerman called attention to the guidelines governing integrity in graduate study adopted by Indiana University and distributed to CIC graduate deans, and he commented briefly on the structure and organization of the review process established by the University of Minnesota's Student Conduct Code. Under the Student Conduct Code, a graduate student who appeals a decision of misconduct at the department level does so before an all-University, not a Graduate School, body. At issue was whether a mechanism should be created for appeal to a Graduate School committee in the case of a grduate student accused of academic misconduct. After a lengthy discussion in which it was acknowledged that several questions concerning the existing structure require clarification, consensus emerged that while infractions are more serious at the graduate level, they are also infrequent and are most often resolved in the department; rather than set up a special Graduate School committee to deal with an isolated instance of academic misconduct, the Graduate School should instead have input to the all-University committee if a graduate student appeals a departmental judgment.

Mr. Linne observed the broad scope of the Indiana document and suggested that similar guidelines be formulated for graduate students here. (Copy of "Integrity in Graduate Study: A Graduate School Guide" attached with these minutes)

F. Membership of the Duluth Graduate Fculty Committee

Attention was called to an attachment to the Graduate Faculty Committee minutes of September 11, 1984 and to the constitutional bylaw describing the composition and function of this Duluth committee. Professor Hedman explained that if the word "those" in the second sentence of the first paragraph of the bylaw is interpreted to mean representatives to the Policy and Review Councils, "election" of Graduate Faculty Committee members is not possible because of the small number of graduate programs at Duluth. He suggested, and Executive Committee members concurred, that "those" instead be broadly interpreted to mean programs.

At Professor Hedman's request, it was decided that the Education and Psychology and the Language, Literature, and Arts Policy and Review Councils should consider whether the Duluth graduate programs which fall within their respective jurisdictions should each be entitled to individual representation on the Councils or continue to be represented in combination. Professor Lange reported that the Education and Psychology Council had considered the matter of individual program representation last year and had voted to retain its present structure under which related programs share a single representative. (Copy of attachment to GFC Minutes attached with these minutes)

G. Reinstatement of Faculty Review of Ph.D. Thesis Proposals

Dean Holt explained that when members of the Graduate School staff are unable to determine whether a Ph.D. thesis proposal is appropriate to the major field or is of sufficient depth, the questionable proposal is referred to him, and he consults with faculty knowledgeable in the area of the student's particular interest. At issue was whether this ad hoc arrangement is acceptable or whether a Graduate School committee should be established to review Ph.D. thesis proposals. Several views were expressed. Mr. Linne reported that in his program the thesis proposal serves as the focus for the preliminary oral examination and is thus well-reviewed prior to submission to the Graduate School, making review by a Graduate School committee superfluous. Professor Sucoff agreed that review and approval of Ph.D. thesis proposals is the responsibility of graduate programs and that a special committee should not be designated for this purpose. Dean Holt suggested that to encourage programs' responsibility in this regard, examination of thesis proposals could be included in program review. Dean Hein mentioned that a bias exists against the humanities and social sciences in the review of thesis proposals by the Graduate School staff, since these are the areas in which staff members received their own degrees.

No decision was reached. Dean Holt said he would propose a policy on this matter to the Executive Committee at a future meeting.

## III. FOR INFORMATION

### A. Report from the General Research Advisory Committee

Dean Sheridan reported at length on available Graduate School faculty research funds for 1985-86 (up to 10-13 percent this year over last) and on recent developments with respect to distribution and use of these funds. Among the items mentioned were Graduate School efforts to introduce a uniform policy governing faculty research funds awarded through various offices of the University and to achieve better coordination among these funding sources (for example, by synchronizing application deadline dates); eligibility of new faculty members not yet on board for start-up funds; the possibility of departments maintaining budget records for their Graduate School research accounts; plans to computerize applications for Graduate School research grants; and attempts to cover lapses of research funding--a problem in the health sciences, particularly --through additional funding in areas where this occurs.

### B. Report from the Graduate School Fellowship Committee

Professor Gray called attention to the recommendations of the Fellowship Committee concerning the direct allocation to departments of 75 percent of the funds they received this year for use in 1985-86 and to the criteria proposed for the competitive distribution of the remaining 25 percent of these special fellowship monies. Dean Holt stated that he would like the Policy and Review Councils to consider the criteria recommended by the Fellowship Committee; if there is agreement on the criteria, departments will be invited to submit proposals for the balance of the funds. He expressed his desire to allocate 75 percent of the funds now, however, to maximize their effectiveness in recruiting for the coming academic year. Discussion followed. Mr. Linne questioned whether the automatic distribution of 75 percent of the funds was equitable if based on the amount of special fellowship funds a department received in the previous year. Professor Thompson pointed to the importance of the quality of the applicant pool as a criterion, but added that this is determined largely by GRE scores; this examination is not required by all programs, however, nor is it available in some program areas, he said.

It was agreed that the criteria should be a discussion item for the Policy and Review Councils this fall.

C. Status Report on Graduate School Tuition
D. Update on Biennial Budget Request
E. Graduate School Budget for 1984-85

(No report was given on items C. and E. Item D. was covered extensively in Dean Holt's presentation of the report of the Task Force on the Quality of Graduate Education and Research.)

F. Update on Internal Graduate School Developments

Dean Holt reported that the Graduate School is currently reviewing bids for a computer system to be used in its admissions area. It is hoped that the system, expected to cost in the neighborhood of $100,000, will be selected by the end of the current fall term.

G. Update on Duluth

Dean Holt reported that Professor Hedman is serving as acting Assistant Graduate School Dean at Duluth and that a search is underway for an individual to fill this position on a permanent basis.

H. Update on Program Reviews

Dean Zimmerman reported that the following programs will be reviewed in 1984-85:

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| Fall | Public Affairs<br>Design, Housing, and Apparel<br>Statistics<br>Civil and Mineral Engineering |
| Spring | Anthropology<br>Educational Administration<br>English<br>Physics and Astronomy |

Two additional programs (one in the area of education, the other in agriculture) may be scheduled for review this spring, however plans have not yet been finalized.

I. Update on Recommendations for Institutional Policy Governing Integrity in Research

Dean Holt reported that he has forwarded the recommendations formulated by the Health Sciences Policy and Review Council and discussed by the Executive Committee in June 1984 to the University Senate Committee on Research for consideration.(Copy of Dean Holt's letter of 10/5/84 to J. L. Sullivan attached with these minutes.)

J. Report of the Board of Regents Action with Respect to Degree Program Additions/Deletions

Ms. Field reported that since the Executive Committee's last meeting, the Board of Regents had approved the discontinuation of the undesignated M.S. degrees in Anesthesiology and Dermatology and of the Ph.D. degree in Hispanic Linguistics. Final approval was also given to the new Plan B M.S. Degree in Microbial Engineering. Proposals for an M.S. degree program in Biomedical Engineering and for a minor in Neuroscience for the Ph.D. degree were given initial consideration. (Copies of these proposals attached with these minutes.)
(**Note**: Not reported but also acted upon by the Regents and forwarded to MHECB was the proposal for an M.A. degree program in East Asian Studies.) (Copy of proposal attached with 11/20/84 minutes.)

K. Old Business

Mr. Linne recalled the request last spring to add a voting student member to the Graduate School Fellowship Committee, which the Graduate School has determined is not consistent with its constitution. Dean Holt pointed to the Fellowship Committee's dual function of recommending policy and reviewing applications for and making recommendations to the Dean concerning the award of fellowships. Since the latter function requires review of student records, student participation in this regard would be inappropriate. He suggested that on an interim basis and until the constitution could be amended to formally permit limited graduate student involvement on the Fellowship Committee, a student could be included in an advisory role with respect only to matters of policy.

The meeting was adjourned.

Respectfully submitted,

Vicki Field
Assistant to the Dean

# CRITERIA GOVERNING CONTINUED GRADUATE FACULTY MEMBERSHIP FOR PROFESSORS EMERITI

Graduate School policy has traditionally permitted graduate faculty members whose status has been terminated due to retirement to complete outstanding examining committee and advising assignments if they wish to do so, but not to accept any new ones. For a variety of reasons--for example, because of early or phased retirement, or because funding for a research grant which involves graduate students extends beyond the date of the principal investigator's retirement--it may be desirable in a limited number of cases to continue a faculty member's Graduate School appointment after he or she retires from the University. Continued graduate faculty membership for professors emeriti is intended to be the exception rather than the rule and shall occur only when the faculty member and graduate program mutually agree that a legitimate need exists to continue the Graduate School appointment after the date of retirement. If such an agreement is reached, the following procedure shall be required and the conditions listed below shall apply.

Professors emeriti who wish to accept new advising and examining committee assignments beyond the date of their retirement and who wish to remain actively involved in one or more graduate programs with respect to advising and evaluating the performance of graduate students and conducting and directing research may apply for continuation of their graduate faculty membership. Application shall be made by the faculty member through the Director of Graduate Studies of the program in which continued graduate faculty membership is desired, or by nomination by a member of the graduate faculty in the same program with the nominee's consent. The Director of Graduate Studies shall submit the nomination to the members of the graduate program eligible to make a nomination to that status, or to a designated committee of the program, and shall after their review attach to the nomination 1) the vote of the faculty or committee with a summary of the views expressed about the quality of the nominee's involvement in the graduate program and 2) a statement describing the need for continued appointment. The nomination shall be accompanied by a letter from the nominee stating that he or she agrees to accept the range of responsibilities associated with appointment to a particular rank, including the obligation to meet with graduate students on a regular basis during the period of continued appointment. The Director of Graduate Studies shall forward the nomination and supporting documentation to the Graduate School for submission to the appropriate Policy and Review Council. The Council shall review the nomination and forward the file with its recommendation to the Dean, who shall decide whether to grant continuing status in the graduate faculty. Final Graduate School approval shall be contingent upon approval by Academic Affairs of a Personnel Action Form (PAF), which that office requires in all cases, whether the professor emeritus is appointed with or without salary.

Membership shall normally be for a limited term, ordinarily three to five years. Renomination shall be at the request of the faculty member and shall be accomplished by repeating the procedure described above.

Individuals seeking continued graduate faculty membership are not eligible to vote on their own nomination should nomination occur before the actual point of retirement.

Graduate programs shall clearly identify professors emeriti who continue to hold graduate faculty membership, and students shall have the right to accept or decline a faculty member so appointed as an adviser or member of the student's examining committee. When a professor emeritus is assigned to advise a graduate student, a co-adviser who holds a graduate faculty appointment appropriate for the purpose shall also be assigned (for example, to ensure that an adviser is in place should the professor emeritus leave the University). The names of professors emeriti whose Graduate School appointments have been continued shall be listed in the Graduate School Bulletin and Graduate Faculty and Limited Teaching Status Roster.

Because the University does not encourage reliance on retired faculty for classroom teaching, involvement of professors emeriti in the activities of graduate programs should primarily concern advising of graduate students, service on examining committees, and limited participation in graduate courses. Extension of a graduate faculty appointment beyond retirement does not entitle the bearer to participate in faculty governance.

October 12, 1984

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James W. Bodley, Department of Biochemistry

Thomas J. Bydalek, Department of Chemistry, Duluth

Richard, S. Caldecott, Dean, College of Biological Sciences

Shirley M. Clark, Department of Educational Policy and Administration

H. Ted Davis, Department of Chemical Engineering and Materials Science

Marcia M. Eaton, Department of Philosophy

Stephen G. Gasiorowicz, School of Physics and Astronomy

David W. Hamilton, Department of Anatomy

Robert T. Holt, Chair, Dean, Graduate School

Johannes C. Nitsche, School of Mathematics

J. Bruce Overmier, Department of Psychology

William T. Peria, Department of Electrical Engineering

Ronald L. Phillips, Department of Agronomy and Plant Genetics

Donna Schlagheck, Graduate Student, Department of Political Science

Richard H. Skaggs, Department of Geography

Neil T. Storch, Department of History, Duluth

Andrew H. Van de Ven, Department of Strategic Management and Organization

George T. Wright, Department of English

## Report of the

## Task Force on the Quality of Graduate Education and Research

Summary of the charge to the Task Force from President C. Peter Magrath:

> "The task force [on the quality of graduate education and research] is being established as part of the current cycle of institutional planning... I am...personally strongly committed to the pursuit of this topic. It obviously involves an area that is of primary importance to an institution such as the University of Minnesota. Addressing it at this time is especially appropriate, since recent national reviews and rankings of graduate programs have pointed up both our considerable strengths and some of our potential weaknesses. It is of course not our intention to substitute a crash program limited to a particular planning cycle for the continuing attention that must be paid to the disciplines and programs that constitute the core of a major research university. Rather, we are focusing attention on this area at this time in order to develop a strategy for addressing more systematically the many complex questions that have to do with the quality of our graduate and research enterprise. I am looking to the task force for recommendations concerning new or revised policies, steps that might be taken to assess more quickly and more regularly the quality of graduate programs, organizational issues that have a bearing on the topic of the task force, funding arrangements, etc."

## REPORT OF THE TASK FORCE ON THE QUALITY OF GRADUATE EDUCATION AND RESEARCH

The charge of the Task Force raises some basic questions about the role and purpose of graduate education and research at the University. In one of the early years of the Graduate School, a new Dean, Guy Stanton Ford, in his first report to the President went to the heart of the matter.

> With the organization of the Graduate School upon an independent basis, the University of Minnesota may be said to have attained its majority. By this act it gave notice that it would henceforth take its place, not as a parasitic institution, living upon the scientific productions of other institutions and other times, but as a contributing member in the advancement of science--the highest function for which universities are organized.

Ford was speaking as a scholar and as an administrator; and if we understand his term "science" to include all branches of knowledge, we can still approve his vision of the University. But we must answer the skeptic's questions, "Why not live on the production of other universities and other times? Why should a public institution, supported in part by the taxpayers of the State, commit resources to what we must acknowledge are the most expensive aspects of the University's activity?" The skeptic may not question the abstract value of graduate education and research but may only wonder, "Why at the University of Minnesota?" A clear answer is to be found in the extraordinary impact that an American university always has on its region wherever its graduate education and research are conducted at a high level of excellence.

Since the end of the Second World War, all modern industrial societies have recognized the importance of graduate education and research by fostering the growth and development of institutions that can carry on fundamental research in a wide range of fields and also provide an advanced education. Some countries acknowledge the crucial importance of these activities by allocating large amounts of central government resources to support a few major universities and, perhaps, research institutes. These institutions--the University of Paris, the Grandes Ecoles, the Academies of Science of the Soviet Union, Tokyo Imperial University--are national institutions in the strictest sense of the term. They are charged with a national, public responsibility and are financed almost exclusively from central government revenues. In the United States, consonant with our mixed private/public economy and federal governmental structure, we have never had a small set of universities established, administered, or primarily financed by the central government or any of its agencies. Instead, graduate education and research institutions in the United States have been decentralized, and fifteen to twenty major public and private institutions, supported by a mix of federal and state public monies and private contributions, have met the increasingly significant national need.

Minnesotans, always sensitive to the argument that states must contribute to the national commonweal if our federal system is to remain strong and vital, have contributed willingly and with distinction. Since the 1920's, their University has been one of the leading ten to twenty research and graduate institutions in the country. As one of the few that combine a basic core of science, literature, and the arts with professional programs in agriculture, education, health sciences, law, and management, it has a special contribution to make and a special reason for developing and maintaining excellence if the nation's full complement of graduate education and research is to remain strong and vital--an imperative if the United States is to meet its obligations to its citizens and beyond.

But the skeptic, if not moved by altruism, might be alert to selfinterest. A university that is strong in graduate education and research provides enormous benefits to its region and to the state in which it is located. The public rhetoric on the role of graduate institutions today is saturated with references to the relationship between excellence in research universities and growth in high technology fields such as electronics and biotechnology. The Boston and San Francisco metropolitan areas stand out as regions where the local economy thrives even when the national economy is sluggish. These are also areas where the strongest graduate and research institutions in the country--Harvard, M.I.T., Stanford, and the University of California at Berkeley--are located. In Southern California, another region that has shown high growth in new science-based industries, the California Institute of Technology and the University of California at Los Angeles have been important to that development. More recently, Texas on the Austin/Dallas axis and North Carolina with its Research Triangle have made moves to become high technology centers. It is not coincidental that the Universities of Texas and North Carolina, in the last two decades, have shown dramatic increases not just in technical fields but in the overall quality of the graduate education they provide across the board.

The Twin Cities metropolitan area stands beside Boston and San Francisco in the birth and growth of high technology firms in the period since World War II. If one standardizes for population and looks at the growth of science-based firms and industries, this region has a record as good as that of any in the country. Literally hundreds of new firms were born in this area after World War II, and some, like the Control Data Corporation and Medtronic, have grown from modest enterprises to become world-wide leaders. But Minnesota's success is not limited to a few prosperous firms; whole industries have grown and flourished here. Computers and information storage and processing began in Minnesota, with Sperry Univac producing the first commercial computer and 3-M taking the lead in information storage. The Twin City area is the world center of biomedical engineering, which was placed on a solid base with the founding of Medtronic in 1949. The post-World War II period was also marked by dramatic changes in the food processing industry as General Mills, Pillsbury, and Multifoods were transformed from firms based almost exclusively on milling into the diversified companies that they now represent. New industries like poultry processing, in which Minnesota is a world leader, also grew up at that time. Mining was given a new lease on life when taconite processing became commercially feasible. If in the past Minnesotans had concentrated on preserving old industries and obsolete jobs, ramshackle sawmills would line the Mississippi north of St. Anthony Falls, flour mills would dot the cityscape, and poverty would be a devastating problem for the state. We today are fortunate that energy and intelligence were concentrated on the creation of a new economic structure.

During the time when Minnesota dramatically and successfully shifted from an economy based primarily on extractive industries, with a minimum of material processing, to an economy based on high technology and the provision of management services through world headquarters, the University's Graduate School ranked among the ten best in the country. The physical sciences, engineering, biological sciences, humanities, and social sciences all included departments that ranked in the top ten in the country in 1957 and/or 1964. In addition, there were premier research departments in the Institute of Agriculture; the Medical School, with a fruitful collaboration between surgery and physiology, was one of the world leaders in research and development of new life-saving medical technologies.

Throughout this period there was a clear relationship between excellence in research at the University and the transformation and growth of Minnesota's economy. The interaction between Medtronic and University research was crucial to the initiation of that firm in the late 1950's and to the later growth of the biomedical industry in this region. Taconite processing was invented at the University. Close ties have existed between the University and the new information processing industry. Modern scientific agriculture would be impossible without a research base in such universities as Minnesota.

The relationship between strong universities and regional economic growth through new firms and industries is not based exclusively on strong engineering programs. What has distinguished the University of California at Berkeley, Harvard, M.I.T., Stanford, and U.C.L.A. (and Minnesota in the late 1950's) is their remarkable across-the-board strength. These are not engineering schools with just a few service departments in the arts and sciences; they are first-rate in the humanities and in the biological, natural, and social sciences. Some universities with a reputable engineering division and a weak arts and sciences core, simply have not had a comparable impact on their regions. The reasons become apparent when we look at some distinguishing features of the Boston, San Francisco, and Twin Cities metropolitan areas. Famous for their quality of life and for the richness of their cultural settings, they attract the kind of people who can make an economy dynamic. To such people, some of the social sciences pursued at a university will be directly useful because they feed the study of techniques and strategies of management that are crucial to the growth and development of new firms: when young firms fail, they are usually brought down not by inferior products but by uninformed managers. But the arts and humanities also play an important role here. As a rule, the men and women who direct a region's successful firms have been liberally educated themselves, and they expect the communities they live in to offer extensive and diverse cultural opportunities. A university strong in the arts and humanities is needed to provide and support the cultural enterprises that help make a region attractive to its energetic citizens.

Not that the arts and humanities should be valued only for the contribution they make to the economic and cultural life of the region. Along with the sciences and social sciences, the arts and humanities provide the human being's most profound ways of formulating our knowledge of what we are and how we live. A university functions nowadays as a center of knowledge for the region it encompasses, but it cannot flourish simply as a source of practical ideas, technologies, and consultants; it must also be constantly engaged in a quest for knowledge and understanding, apart from any practical application. Accordingly, there is general agreement that the University's core is its programs in the humanities, the sciences, and the social sciences, and that other areas of the University acquire at least some of their effectiveness from being incorporated in a university devoted centrally to the pursuit of knowledge. In the long run, the disinterested pursuit of knowledge for its own sake makes itself felt in a higher standard of human achievements.

This argument leads to a third practical reason why quality in graduate education and research is important. In large universities, excellence in undergraduate education is heavily dependent on a high-quality, research-oriented graduate faculty. The members of this Task Force share the view that the University must meet those responsibilities to undergraduates that are implicit in the very concept of a public, urban university; but they also agree that these responsibilities cannot be met unless its undergraduate education is based on an atmosphere of intellectual challenge and excitement created by the research endeavors of its faculty and by the dedicated involvement of graduate faculty and their graduate students in undergraduate education. This is the basis of quality undergraduate education at other major research universities whether private or public.

It is difficult, if not impossible, for a large urban public university to offer a first-rate undergraduate education without a strong graduate program and a firm commitment to research in all major areas. The reason is clear. Professors who dedicate themselves mainly to undergraduate education often find the large urban university with oversized classes, little extracurricular campus life, no teaching assistants, and modest commitment to research an uncongenial setting in which to teach undergraduates. Such teachers are frequently persuaded to accept positions in undergraduate colleges which provide a more hospitable environment, leaving the large urban undergraduate college with a faculty which would prefer to be elsewhere. Undergraduate education suffers.

We can see, then, the reasons why excellence in graduate education and research is central and crucial to the University. (1) It meets Minnesota's responsibilities within our federal system for helping to maintain a first-class national research and graduate establishment. (2) It is a <u>sine qua non</u> for a strong, vibrant, and dynamic Minnesota economy and a vigorous cultural life. (3) It is an essential ingredient in the provision of quality undergraduate education and necessary if we are to meet our responsibilities as an urban, public university. There are, of course, the pragmatic reasons for supporting graduate education and research at the University of Minnesota. There is a more fundamental justification. Rooted deeply in the core of western civilization is the idea that the pursuit of knowledge--the search for truth and beauty--is to be highly valued in its own right. This value is institutionalized in our graduate schools which foster the search for truth and prepare the next generation of researchers and teachers. The mountain of the unknown is infinite, but what is a greater challenge for each generation of finite humans than to master the higher terrain?

The skeptic should become a believer. But to accept the proposition that there must be high-quality graduate education and research at the University of Minnesota is only a beginning. A number of specific steps must be taken to maintain and improve the quality of University programs. Recommendations for action are made in the final section of this report. Important as these actions are, however, they are likely to be ineffective unless there is widespread consensus among faculty, administration, and the Board of Regents on five fundamental assumptions.

1. <u>The commitment to excellence is the basic imperative</u>. The Lilly Task Force commented, "It is <u>not</u> obvious today that the University of Minnesota has a genuine commitment to excellence, especially in programs that lean most on legislative support..." This does not mean that there is no concern with excellence; the very establishment of this Task Force by the President is clear testimony to that concern. But the concern does

not permeate the University, and it does not operate as a crucial consideration in every decision. When the recent national ratings of graduate programs were published,[1] the University of Texas (Austin) had the same number of programs in the top ten as Minnesota, and Change magazine, in its review of the ratings, showed Minnesota and Texas tied for sixteenth place among the country's best graduate schools. The President of the University of Texas commented on Texas' rankings: "I would hope that ten years from now when someone asks which are the best universities, we will be in the top two or three." He went on to add that if his university does not achieve that lofty goal, it will not be for lack of trying. In a similar spirit, some professors and administrators at Minnesota have used the occasion of the ranking to re-dedicate themselves to the pursuit of excellence and to the building of strong departments and a better University. Such a commitment to excellence must pervade the University if we are going to improve the quality of graduate education and research in any significant fashion. When promotion and tenure decisions must be made, when resources are to be allocated or withdrawn, every alternative should be weighed on the basis of its impact on the building of excellence.

2. The quality of excellence is indivisible. Excellence in some fields cannot survive alongside mediocrity in others. Graduate students deserve and expect to find high quality in all the fields in which the University offers programs. If excellence is achieved and maintained only in selected areas, the best students (both graduate and undergraduate) may choose to study elsewhere, and the best faculty may either decline to come

[1]See Appendix for a listing of the overall ratings as tabulated in Change (May/June, 1983), p. 18.

to Minnesota in the first place or be easily lured away. When quality is maintained unevenly from department to department and from college to college, when mediocrity is permitted to exist anywhere, everyone is likely to feel dissatisfied and even demoralized. A broad base of excellence is necessary if we mean to retain our best programs, our best faculty, and our best students, and to make our full contribution both to the economy and to the quality of life in Minnesota.

In today's environment, attention to building excellence is apt to be concentrated heavily on professional and technical programs. In the public's eye, these are the only fields that seem to have much impact on regional economic growth, and the humanities and the social sciences are ignored or treated as mere service units for students in more "practical" fields. Where this strategy has been tried--to build up engineering and relegate other fields to a mere service role--it has failed. Even the engineering has become second-rate. M.I.T., the best of the technical universities, has quality programs in the social sciences and in the humanities.

This does not mean that every program at Minnesota must be strengthened simultaneously. It does mean, however, that we must, over a five to ten year period, provide support for all our programs and encourage them all to achieve excellence.

It follows from this concern with the indivisibility of excellence that <u>the University of Minnesota should maintain a single Graduate School with jurisdiction over all graduate programs on all campuses</u>. Graduate education on all campuses would be enhanced by greater coordination and cooperation between campuses and among programs. A unified Graduate School is best able to advocate and facilitate this policy. Several models are appropriate for intercampus cooperation in graduate education: exchange of faculty and students among separate programs on different campuses, branch programs on a campus where some of the degree requirements can be completed, a single graduate program with faculty drawn from two or more campuses, or a single graduate program with faculty on two campuses and students able to complete all degree requirements on either campus. In any case, the Graduate School should set up intercampus committees to bring about greater cooperation between campuses and programs.

3. Graduate education and research are part of the same enterprise. There is considerable misunderstanding about the nature of graduate education. Many conceive graduate teaching as simply a continuation at a more advanced level of undergraduate teaching. Graduate teaching, however, is not merely an extension of a professor's undergraduate teaching; it is basically an extension of his or her research. Effective graduate instruction in a university typically involves a rich and vital research undertaking, and productive research in many fields requires the participation of graduate students.

4. At the graduate level, there is little difference between major public and private institutions. We compete for the same students, and for the same faculty, and we rely heavily on the same sources for the financing of research. When we seek standards for comparison for graduate programs, therefore, the Big Ten institutions as a whole no longer provide an appropriate basis for reference. Comparisons must be made with the best graduate institutions in the country, whether private or public.

5. At the gradute level, the University must be viewed in a world-wide context. Many taxpayers tend to view the public university as a place

where their children have special access to a quality low-cost education. However appropriate this view may be for undergraduate colleges, it is the death knell for a graduate school. At the graduate level, the University most effectively serves the State by bringing to Minnesota the best students from across the country, in addition to providing opportunities for Minnesota residents who can meet high entrance requirements. To sustain and improve its standing as one of the world's impressive centers of learning, the University must attract first-rate students, hire and retain a distinguished faculty, keep abreast of and contribute to the fund of available knowledge in the world today, and be guided by the highest standards of research and creative performance. Only by welcoming new ideas and able people that come to us from outside can we generate the high-quality research essential to a state that must increasingly live by its wits, and provide Minnesota firms with the trained personnel they need to compete successfully in world markets.

The specific recommendations in the sections that follow have been approached in the light of the situation and assumptions presented above. The problems that are addressed are complex and difficult to solve, but we are convinced that actions in accordance with our recommendations will substantially improve the University of Minnesota's standing among the country's leading universities.

## Recommendations for Insuring a Quality Faculty

To improve the quality of graduate education and research at the University means to enhance the quality of the faculty. The specific steps that should be taken to improve the quality of the faculty are constrained by the fact that resources are limited and must be carefully allocated so that they will have maximal impact.

For the purposes of analysis, we have divided the faculty into two groups: (1) those who will be added over the next few years, and (2) those who are already at the University. The number in the first group is a function of the "replenishment rate" adopted by the University and its colleges. Our assumption is that this rate is going to be modest; 70-80 percent of the faculty who will be at the University in 1990 are already here. There will, of course, be considerable variation; some departments and programs may, in the next few years, include a high percentage of new faculty.

The implications are threefold. First, selection and recruitment of new faculty will require very special attention because each new faculty member is more crucial to institutional vitality, graduate education, and our ability to operate on the frontiers of the disciplines than has hitherto been the case. Second, special efforts and attention must be given to providing means by which faculty can renew themselves and enhance their scholarly or artistic capabilities and productivity. Third, we must be effective in retaining outstanding scholars at the University.

## Compensations

To attract and retain high quality faculty, salaries must be competitive in two ways. First, we must be competitive with respect to other universities of national and international reputation. Failure to provide reasonable compensation (as defined by a variety of market factors within and across professions) ensures that many of the most able and creative people, already committed to the academy, will choose other universities. Second, and more problematic, we must provide direct and indirect compensations that will encourage the most promising young people to seriously consider an academic career so as to become the future generation of teachers and researchers.

**Recommendations**

1. The highest priority should remain that of seeking legislative appropriations and other funds to make all faculty salaries competitive.
2. While the University provides relatively good fringe benefits compared to other universities, some universities have specific benefits that are very attractive to some faculty. Most notable are university support for home mortgages (this has a particular appeal to young faculty) and tuition grants in some form for the children of faculty members. Such benefits could give us an enormous and effective competitive advantage when we try to recruit or retain faculty. The members of the Task Force recognize that these specialized fringe benefits will be of great help to some faculty and of limited usefulness to others. Therefore, we favor a "cafeteria" benefits package from which all faculty might select those benefits which met their particular needs.

   We recommend that the Senate Committee on Faculty Affairs meet with the Vice President for Finance and Operations to propose additional fringe benefits that would make the University more competitive in recruiting and retaining quality faculty.

3. If the University is to aspire realistically to rank with the top ten research and graduate schools in the nation, it is with the top ten research universities, whether private or public, that salary comparisons must be made. The Big Ten, or some other general group of institutions within the Association of American Universities, is not the most appropriate reference group. The Universities of Michigan, Wisconsin, Illinois, and California at Berkeley and at Los Angeles, M.I.T., Yale, Princeton, Chicago, and Stanford are among the public and private institutions with which we must compete effectively for high quality faculty.

Recruitment

Recruitment of new faculty to the University must be informed by the realities of the 1980's. Most significantly, the number of new appointments will be relatively low when compared to the 1960's and 1970's. Correcting mistakes in hiring through the denial of tenure is both difficult and inefficient, and the concern has grown that minimal standards for tenure may become operating standards. Searches are costly both in money and in faculty time. It is, therefore, important to hire faculty who are extremely likely to excel and achieve tenure.

**Recommendations**

4. When it is appropriate, new faculty should be selected from among proven scholars. "Proven" does not necessarily mean "senior," but in many fields the information available on new Ph.D.'s does not allow us to make good predictions on their success in research and teaching. The

research record of the first two or three years after receiving the Ph.D. often provides a much better basis for judging potential. While hiring these people may cost a few thousand dollars more than hiring a new Ph.D., the increased advantage to the University is well worth the greater expenditure.

In those cases where departments or programs can be dramatically improved by senior appointments, we recommend that the administration not hesitate to make them.

5. A special centrally held fund should be established for start-up costs for new faculty. Appropriate uses of this fund would include equipment, space remodeling, and supplemental support personnel for a limited term, among others.

Retention and Revitalization

At any one time only a small percentage of the faculty are new. The strength of the faculty is determined more through effective retention and vitalization than through the acquisition of new blood. Vitalization and retention are closely related. Those members of the faculty who remain vital and active in research and graduate teaching are the ones who are most important to retain, but they are often also the ones who are attracted to and sought by other universities. A university that provides opportunities and incentives for faculty to remain vital engenders the institutional loyalty and commitment that makes retention easier.

**Recommendations**

6. The University should continue to seek retention funds as a recurring item from the legislature. These funds should be used not only to counter firm outside offers made to individuals we wish to keep, but

also for preemptive retention efforts. Each college should regularly evaluate its faculty and provide appropriate rewards and encouragement to those who, through effective research and graduate teaching, have identified themselves as individuals the University wants to retain. Such retention efforts may involve salary, equipment, space, and other support critical to fostering the work of those individuals.

7. Junior members of the faculty deserve special attention. To continue active research after receiving the Ph.D. and taking on a full load of teaching responsibilities can be difficult. We propose that the University establish a program of junior faculty fellowships. Ten or more junior faculty would be chosen each year in University-wide competition; each would receive three quarters of research appointment with full salary paid from central sources over a three-year period and could draw from a pool to be established for research expenses. This kind of program would at the same time advance the careers of young faculty and create a sense of institutional loyalty.

   Sponsorship of junior faculty may take other forms beyond the important one of special monetary awards to support research and scholarly work. Senior faculty might act as guides, facilitators, and mentors to their less experienced peers. Provision of information, advice and help may be particularly important to the integration and success of faculty in underrepresented groups. The University could establish a variety of sponsorship strategies or programs. We recommend that collegial groups take deliberate steps to assist their junior members in their career development.

8. Research professorships should be created for tenured faculty. These

awards would be of limited duration--one to three years--and allow specially focused research efforts to exploit unusual research opportunities. They would not be in lieu of sabbaticals. A rate of one percent of faculty on such professorships in any given year would seem reasonable.

9. The General Research Funds of the Graduate School must be greatly increased and the criteria for their usage expanded. At the present time our Medical/Cancer and General Resarch Funds total about $1,500,000. Our leading competitors such as the Universities of Wisconsin and Illinois have, respectively, about $7,000,000 and $4,000,000 annually available for similar purposes. At Minnesota such funds should be continually used for seed money for younger or newer faculty, but they also should provide opportunities for more established faculty to develop and initiate new research thrusts, supply matching funds for equipment costs, cover the emergencies that may be created by the temporary loss of outside funding, and support travel related to the development and funding of research projects.

10. To ensure the vigor and productivity of our faculty by increasing their scholarly opportunities, sabbaticals should be made a more viable option than they are at present. Sabbaticals have long been under-utilized and this does not redound to the benefit of the University.[2] For the University to benefit by increased use of sabbaticals, we propose

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[2]Darwin D. Hendel and Jeanne Solberg, in a study conducted in 1983 as part of the evaluation of the Bush sabbatical program, found that about one-third of the faculty who are eligible take a sabbatical during any given year.

greater flexibility in the use of such leaves and the possibility of increased support levels during the leave.

11. Graduate teaching is different in kind from undergraduate teaching and excellence here should be recognized. The Graduate School should establish a set of awards focusing upon faculty achievement in instruction.

    A parallel set of awards for excellence in guiding research should be instituted. A secondary purpose of these awards would be to give full recognition to graduate instruction as legitimate activities of the faculty.

12. The Graduate School should undertake to sponsor recurring symposia in selected fields across the University. The product of these symposia published as a serial in the field can bring recognition to the University as well as new ideas and people to our campus. Ten such series at a total cost of about $100,000 would be an excellent investment in bringing the University to the leading edge in many fields.

13. Incentives, or at least the removal of disincentives, are required for those activities which bring honor and recognition to the University and give it a place in national leadership. These activities include the following: editorships, grant advisory panels, presentations of papers at national and international meetings, travel in connection with the holding of national society offices, publishing works, or putting on shows. Currently these activities are encouraged but not strongly supported with dollars, staff, or merit recognition. Indeed, in some units faculty are discouraged from accepting the responsibilities of senior scholars in their fields because the unit cannot afford the

travel, postage, space, technical secretarial assistance, and other costs associated with these contributions to excellence. We are convinced that the University cannot afford to reject these opportunities, and we recommend the institution of policies that not only make acceptance of such activities the norm, but also provide resources for faculty who take on important scholarly-related outside activities.

14. The Graduate School should explore ways of promoting recognition of existing quality and emerging centers of excellence within the University. Broad recognition of excellence will benefit the University in the recruitment of faculty and graduate students and in the seeking of extra-mural support.

15. Indefinite tenure is a mechanism to protect academic freedom in educational institutions. Appointment with indefinite tenure normally occurs at promotion from Assistant Professor to Associate Professor, after a probationary period of up to seven years. The criteria for promotion are important to assure maintenance of quality of the faculty at the University of Minnesota. The recent Tenure Code revision (which is now being debated in the University Senate) incorporates the criteria for promotion into those for awarding tenure. On occasion, however, indefinite tenure at lower ranks has been granted without promotion, a practice which suggests that job protection rather than protection of academic freedom has been the main criterion in the decision. This is in direct opposition to the stated goals of excellence at the University and should be discontinued.

## Recommendations on Graduate Student Support and Recruitment

The improvement of graduate education requires high quality graduate students. This means that there must be a good supply of high quality applicants and the kind of excellent programs, competitive financial aid, and educational amenities required to entice those who are admitted to accept Minnesota's offer over that of competing institutions.

The task which lies ahead will not be an easy one. The number of seniors graduating from U.S. colleges and universities begins falling dramatically in 1986. But the "needs" of major research universities will not decline commensurately. Unlike the situation in many other countries, universities in the United States are a central and major component of the national research establishment. Basic and applied research done in our universities provides the new knowledge so essential to the well-being of the nation. Graduate students in the role of research assistants are crucial to the vitality of the research effort. But the major research universities also use graduate students as teaching assistants who are integrated into their teaching mission. While the total number of undergraduates in American colleges and universities will decline in the 1980's, the major research universities will not see their undergraduate enrollments drop significantly and will continue to need graduate students as teaching assistants.

Thus, while the supply of new graduate students as measured by the number of graduating seniors in U.S. colleges and universities will be declining, the demand for new students in the major research universities will remain high. Competition for quality graduate students will become fierce. The University must be ready to compete effectively in this new environment or the quality of graduate programs will decline significantly. It is not in a strong position now. Only about 40 percent of the cost of a graduate education, including tuition, room and board, books, and other necessary expenses are met by financial awards at the University of Minnesota. At the University of Wisconsin it is about 75 percent, and many other institutions including Michigan, Berkeley, U.C.L.A., and Illinois do better than Minnesota in this regard.

Per credit tuition and the application of the funding formula are serious impediments to progress in improving the quality of graduate education. Early in our deliberations, the Task Force members took a position in favor of the abolition of per credit tuition. We did not advocate any specific alternative because the Graduate School immediately took the initiative. It was far more appropriate for the details to be worked out by the Dean working with the Executive Committee of the Graduate School, and, despite the uncertainty we feel about the effect of these new proposals on some classes of graduate students, we commend the efforts to develop a new tuition structure to be put in place by the fall of 1984.

Cost-related tuition poses an equally knotty problem. The 1983 legislative appropriation for the University assumed that tuition would be equal to 31 percent of instructional costs in 1983-84 and 32 percent in 1984-85. At the time that the bill was passed, graduate tuition met 18.6 percent of instructional costs. As pressures arose to set tuition in all units of the University closer to the average of 32 percent, the debate over whether tuition in the Graduate School should be near 32 percent intensifed. We have not examined all of the facets of this debate but one conclusion is clear: we must improve our competitive financial position relative to other major universities regardless of the final resolution of the cost-related tuition debate. Tuition must be stabilized and student aid must continue to rise.

**Recommendations**

Tuition and Student Support

1. The University must closely monitor tuition rates and student aid packages at the major research universities and take the steps necessary to be in a strongly competitive position. At the present time, there must be a dramatic increase in funds for fellowships, teaching assistantships, and research assistantships. Both the number of financial awards available and the size of the stipends associated with them must be increased signficantly if we are to be competitive for the next four to five years.
2. Some of our major competition for outstanding students comes from universities that offer multi-year fellowship packages. One of the weaknesses of our graduate fellowship program is that departments and programs must provide the second and third years of support with graduate assistantships. A major effort should be made to provide three-year fellowship packages. This would require tripling funds just to expand the existing program to a three-year program for the same number of students. A start could be made, however, by using funds administered by the Graduate School to generate tuition fellowships for second- and third-year graduate fellows.
3. The University should provide incentives for increasing the number of research assistantships available for graduate students by making determined efforts to acquire outside grants.

4. Some portion of Graduate School fellowship money should be allocated directly to departments and programs by January of each year so that they can be used to enhance recruitment of graduate students and develop graduate programs. Departments and programs should have a great deal of discretion in using these funds.
5. Special attention needs to be paid to what are likely to be increasingly difficult problems in recruiting and retaining first-rate graduate students in certain fields like the humanities and mathematics. Because of the reduced number of academic positions available to people with doctorates in these fields, bright undergraduates are already being discouraged from continuing their studies at the graduate level, but in less than a decade we will need new Ph.D.'s to meet the increased demand for faculty at universities and colleges.

Along with these measures, the University and the Graduate School should look more closely at their own fiscal practices, in particular at the assumptions and formulae that underlie the calculation of the cost of graduate education. Many parts of the University accrue benefits from graduate education and research, but often without financial obligation on the part of those who receive those benefits. Benefits should appear on the credit side of any ledger that seeks to establish the cost of graduate education.

Cost Accounting Models and University Resource Allocation

6. We recommend that the Dean of the Graduate School meet with the staff of Management Planning and Information Services (MPIS) to examine the accounting model currently used to compute instructional costs for graduate education. Such an examination could identify changes in

fiscal analysis that would report more accurately the cost of graduate education.

7. An accounting model can deal only with expenditures. The University needs to develop a second model that can encompass benefits as well as costs. We recommend that work begin at once on such a model and that particular attention be given to the benefits of graduate education and research that are real but are not included in expenditure-driven models.

While some of the efforts to improve the quality of our graduate students involve large expenditures of funds for student aid, there are other steps that can be taken that could yield good results without costing any signficant amount of money.

Other Recommendations

8. The Graduate School should hold workshops for directors of graduate studies and recruitment committee chairs to help them effect the best possible recruiting strategies. Some successful departments should be asked to share their approach to effective recruitment. The Graduate School should take the initiative to this end.
9. A fund should be made available to bring prospective students to the campus and to develop effective means for encouraging the students to come to the University of Minnesota.
10. The time spent by students in degree-related teaching and research should not inhibit reasonable progress toward their degrees. It should be emphasized that the major reason for the University providing funds for graduate assistants is to support graduate education.
11. Graduate students, whether from inside or outside a unit, should be

appointed as graduate assistants only when they are making reasonable progress toward their degrees. In the situation where the appointing unit is not the academic unit, both units are responsible for monitoring progress toward the degree; such monitoring can be facilitated by requiring both units to sign the appointment forms.

12. Regular methods should be developed and implemented for consulting graduate students on policies concerning University libraries. In particular, graduate students need access to new books, and libraries should help them gain it. And furthermore, the purchase of books and periodicals should be a matter on which graduate students as well as faculty are asked to consult.

13. To foster the intellectual and social interaction necessary for academic and professional development, more attention should be devoted to expanding a sense of community among graduate students. We recommend that adequate work/study space be designated for graduate students in their departments and that commons rooms be provided where feasible. Another means of encouraging the growth of a community of graduate students would be to reserve space for them in a single dormitory where a community of scholars could be developed.

## Recommendations on Program Reviews

### Purpose

Program reviews, as mandated by the Board of Regents, are incorporated into the Constitution of the Graduate School and all colleges. Programs and units provided with research funding by the Agricultural Experiment Station are obliged, by federal mandate, to undergo periodic review.

The Task Force on the Quality of Graduate Education and Research strongly supports the continuation of unit reviews. These reviews provide an important, and sometimes unique, means of assessing the current health and future promise of academic programs. In particular, external reviews may be the best way to obtain the information needed to strengthen graduate education and research at the University. But for the reviews to be effective, there must be a commitment by the external reviewers to provide guidance and suggestions that lead to excellence in programs, and there must be a commitment by the University, the Graduate School, and the relevant college to take seriously the report of the external reviewers and implement the recommendations.

We also recommend that a very limited number of super-reviews be undertaken. These reviews would examine broad research areas which span unit boundaries and even college units, and their principal purpose would be to determine how collaboration in research and staffing might provide critical size and encourage new directions in research. The effect of such cross-disciplinary reviews would be to counteract the sometimes inhibiting barriers that the bureaucratic structure imposes and to emphasize the common good that can be achieved through cooperative research, staffing, and graduate-level instruction.

The Review Process

Members of the Task Force believe that the procedures used in the first cycle worked well. These procedures included the preparation of a departmental self-survey, a visit and report (oral and written) by an external committee, an examination and report by an internal committee, a response by the faculty of the unit, and sessions to consider and act upon the salient recommendations. The Task Force, however, agrees that the costs in time and money are too high to justify the continuation of these "full" reviews for all 180+ graduate programs. In the second cycle, full reviews should be carried out selectively at the discretion of the deans of the Graduate School and the colleges. We estimate that one-half to one-third of the programs would require a standard review. For the most part, these would include the basic sciences, social sciences, and humanities, and the core units of the professional schools. But even in some of these cases the internal committees might play a limited role or perhaps not be used at all.

One of the first tasks of the deans would be to define the set of programs to undergo a full review. The remaining programs could be reviewed by an internal committee or simply through a formal exchange between the programs and the deans.

Materials

The self-survey report produced in the second cycle should cover the period since the first review and emphasize progress in meeting the recommendations coming out of the first review as well as changes in the composition, character, and functioning of the unit. The budgetary college should be responsible for providing data on fiscal, personnel, and instructional matters. The Graduate School should provide data on graduate students and graduate faculty.

In addition, comparative data from other institutions should be collected. The appropriate pool of comparable (and competitive) institutions should be determined jointly by the deans and the graduate faculty of the unit. The pool of comparable institutions should not be limited to the Big Ten. The University of Minnesota competes for faculty, funding, and graduate students nationally and internationally, and the comparisons should be conducted at these levels.

The Task Force recommends that the unit self-survey documents be updated every two years. These addenda will provide a record of progress in meeting the recommendations that emerge from the reviews. In addition, this information will reduce the amount of work needed in future cycles and will provide reasonable longitudinal data on the unit.

Cycle Length

The Task Force recommends a seven-year cycle, but external circumstances should be taken into account in deciding the timetable. In instances where a unit changes heads, the review would be more profitably done early in the new head's tenure. The format of a review not synchronized with the cycle can be determined by the deans involved.

Action on Reviews

External reviews should be more than progress reports; they should result in plans for action that will bring about improvement and excellence. If the process is to be effective and credible, the University must be committed to act on reasonable recommendations made by external reviewers. Such recommendations should be specific and should help the Graduate School to identify programs that deserve probationary status or that should be discontinued. They should be equally forthright in identifying centers of excellence and suggesting ways to preserve them. For essential units that require aid, reviewers should be encouraged to make specific recommendations on how to solve problems and deal with shortcomings. Indeed, at the conclusion of a review, the reviewers and the University might devise a form of "contract," which would specify both the amount and the nature of the support to be given to the unit in question and would propose a schedule for implementing the recommendations. As a matter of normal academic procedure, even in years when no review is currently being conducted, departments and programs should make a practice of defining and affirming goals and objectives in continuing consultation with deans.

## Recommendations on Central Facilities

### I. Space and Equipment

Workplace and worklife issues are receiving considerable attention in industry, in the public sector and, increasingly, in higher education as concerns for productivity mount. The quality of life of those who work in colleges and universities affects directly the quality and productivity of their institutions. One major dimension of the university as workplace for faculty includes elements of collegial governance and academic culture. Another dimension, to which this part of the report attends, includes the physical environment in which faculty members teach and advise students, engage in research and scholarly inquiry, and provide professional services. Due to the economic pressures of the past decade, new construction has been limited, physical maintenance of campus buildings has been cut back and, in general, expenses for books, equipment, and supplies have been carefully monitored. These and other factors have had a damaging effect on quality of worklife in higher education institutions. The University of Minnesota has not been exempted from these external forces and their internal consequences.

**Recommendations**

1. Just as a mature and aging University faculty may be said to be in need of renewal and revitalization, so also are physical facilities built in earlier eras in need of regular maintenance, systematic refurbishment, and remodeling to accommodate new programmatic needs, new research thrusts, and new activities. We recommend that the planning process be improved to include a better recognition of the specific functional use of buildings for academic programs. An assessment of the physical status of University buildings, schedule of refurbishment and remodeling

should also be routinely included in University planning. In this process, faculty in the buildings should be consulted. Particular attention should be paid to the needs of faculty for research facilities.

2. To make the most rational use of space, it is recommended that while many buildings are planned with the needs of the first incumbents in mind, buildings should not be overly customized. At least some portion of the rooms and facilities within new buildings should become available for collegiate or central assignment, as other faculty members and programs demonstrate need for usage. More general purpose planning of new buildings is recommended to assure their adaptability to changing needs over time.

3. In any new building, consideration should be given to setting aside space to facilitate the inter- or multi-disciplinary research activities of the faculty, e.g., applied research in natural resources, genetic engineering, and biotechnology.

4. To conserve and extend the usefulness of equipment purchased with grants and contracts, and to increase the productivity of faculty and graduate students overall, equipment which is not being used by the original project investigators or by others in their departments and is not needed in the long term should be made available for loan to others on campus (including the coordinate campuses), or it should be offered at low or no cost to other higher education institutions or to schools to enhance their technological resources. Where terms of the grant constrain the buying and selling of used equipment, it is recommended that ways be worked out to accomplish transfer of equipment among projects.

5. The Handbook of Research Services (1981) should be updated and disseminated widely.

II. Libraries

The libraries of the University of Minnesota are faced with four major kinds of problems, all of them interrelated: problems of location, problems having to do with the partition of books and materials among main and departmental libraries, problems of finding money to maintain and improve library acquisitions, and the improvement of library services.

**Recommendation:**

The following issues must be addressed seriously and soon if the University is to maintain and increase its distinction in research.

1. Location. When faculty and students do most of their work far away from the libraries where their essential books and periodicals are located, the result over a period of years is likely to be diminished and weakened research. This is the situation for a large number of departments and programs at the University of Minnesota, particularly in the humanities. In a more temperate climate, the problem might not be so acute, but Minnesota's harsh winters discourage long walks to a distant library. The University must address this problem and find ways of reducing its impact (e.g., by transferring most of the humanities books to that side of the Mississippi River where most of the humanities are located).

2. Main and departmental libraries. One answer to the problem of difficult access to main libraries is the establishment of numerous departmental or disciplinary libraries. But this solution brings with it a train of other problems, especially that of dividing up among several scattered

libraries those books and materials which are relevant to many disciplines. Research under such conditions may involve tedious and time-consuming visits to (and back and forth between) numerous separated libraries, hardly an efficient way to conduct research. At the University of Minnesota, this division of resources is especially troublesome to those who do research in the biological sciences or whose work involves interdisciplinary research in science and engineering.

3. Money. One way of solving the problem of scattered departmental or disciplinary libraries is to provide enough funds for every such library to buy all relevant books and materials, even when such purchases involve duplication or multiplication of University holdings. Although sufficient moneys are not available now (and are not likely to be soon) to make every such branch library in effect an interdisciplinary library, funds should be found to move some libraries further in the direction of a modest self-sufficiency. But funds are even more urgently needed for other basic purposes: to maintain and expand present library resources, to increase acquisitions, and to maintain the full set of library services essential to support a major research university.

4. Staff. A well-trained and helpful professional library staff sensitive to the demands of scholarship can dramatically increase the usefulness of a library to the research of faculty and graduate students. In order to help the libraries to function most efficiently, the University must work to improve its library personnel policies.

## III. Centralization of Major Research Facilities

Historically, most major universities have managed to provide departments and colleges with the funds required to purchase the equipment necessary to enable their faculties to remain competitive in research and graduate education. Notable exceptions have been in the areas of high energy physics and astronomy where advances in understanding the structure of the atom at one end of the natural order and the universe at the other have required outlays of equipment and facilities that were in the order of hundreds of millions of dollars. One of the mechanisms used by the scientists in those fields to obtain the capital funding necessary for their research has been the establishment of multi-university/government consortia designed in such a way that those who were to be the users would share in the cost. The success of these consortia, which has been considerable, is coupled to the agreement that the users would share in management and in the establishment of priorities for the conduct of specific research projects.

In the immediate future it is unlikely that most areas of research in the natural and social sciences will require the enormous expenditures that are essential for advances in high energy physics and astronomy. However, it is clear that within universities annual expenditures for equipment ranging from tens of thousands to tens of millions of dollars will be required continually if quality research is to be conducted in areas such as computer science; computer facilitated research in the natural, social, and applied sciences; modern engineering, physics, chemistry, and molecular biology.

It is assumed that the burden of meeting these equipment needs may often be beyond the capacity of individual departments and colleges and occasionally beyond the capacity of individual universities. To assess this, and to determine where centralized management might play a role, we recommend that a comprehensive study be undertaken for the following purposes:

1) to inventory current departmental, collegiate, and University policies for the purchase and use of research equipment and facilities;
2) to obtain a University-wide inventory of those individual items of equipment purchased during the past five years that cost in excess of $50,000;
3) to obtain an estimate of the rate at which existing equipment that cost in excess of $50,000 is expected to become obsolete and the anticipated cost of replacement;
4) to obtain estimates of the hours per week that major pieces of equipment are currently used and to determine to what extent the equipment could be made available to others when it is not in use;
5) to determine to what extent and under what conditions individual faculty members are now sharing their equipment with colleagues from other departments within the University and with faculty members from other universities. At the same time information should be elicited as to what extent University of Minnesota faculty are using equipment from other universities.

When the data are compiled it should be possible to obtain a realistic estimate of the likelihood that the University will be able to meet the future needs of the faculty for equipment and facilities and to what extent more effective use of some equipment would result from a scheme of centralized but participatory management. It should be possible also to determine whether or not bilateral or multilateral arrangements for the purchase and sharing of equipment between universities warrants consideration.

## IV. Communications Systems

A key element in the effective use of central research facilities is access. The library and computer resources are the most important and ubiquitous central research facilities to which rapid access is imperative. In this connection, the current effort by the University to design and request bids for a new communications system is most crucial. When the time comes to choose among alternative designs and vendors, University officials should keep firmly in mind the goal of enhancing research through innovative use of the new communications system.

We have not worked out in detail the ways in which creative use of the new communications system can influence research productivity. We do not, in the short term, advocate an "electronic university," but we do believe that the new communications system should be seen as an opportunity which if grasped can enhance research at the University of Minnesota. Rapid and transparent access to the library and to information processing should be of the highest priority. The planned electronic library catalogue is an excellent first step, but it must be made widely available quickly, and it must include not only the main library but departmental and specialized libraries, and not only books but periodicals, serials, and documents. Also close to real-time entry of newly catalogued material must be provided. In other words, to serve research the electronic catalogue must be complete and current. Easy access to <u>task-appropriate</u> information processing and computing facilities is equally important. Switching of tasks to appropriate hardware should be automatic and transparent.

Beyond these major functions, a number of lesser but important services can be suggested. An on-line listing of requests for proposals (RFP's) received by the University would be very helpful. An on-line listing of grant application deadlines and grant application formats is important. Interactive budget preparation assistance would aid both faculty and support staff. Electronic transmission of proposals to appropriate offices would save much valuable time. Electronic manuscript transmission for pre-publication comment and review might enhance communications between investigators in allied disciplines. One can even envisage a research "bulletin board" for gathering comments on and collaborators for new research endeavors.

The effectiveness of the new communications system in aiding research is not dependent on the hardware alone. It will be necessary to develop the control mechanisms and programs and to provide the instruction required to maximize the usefulness of the communications system to research. The University should make these developments a high priority.

V. Recommendation

All these interrelated issues compose one many-sided problem, which in the years of expansion since the Second World War has grown more desperate year by year but has never been fully understood or seriously addressed by any responsible University authority. We strongly recommend that a high administrative official--most logically, the new Vice President for Planning --be given authority to address these issues and be held accountable for finding ways to solve or resolve them. Each campus of the University, however multiple and various its uses, must design or re-design its space coherently, and the location and accessibility of research facilities must be recognized as issues crucial to the future of the research mission of the University.

## Conclusion

Among American universities, Minnesota is remarkable for the diversity of its missions. It is a national research and graduate university, a land-grant institution, and an urban public university. Each of these designating phrases implies certain obligations and responsibilities. "Land-grant institution" and "public urban university" imply service and undergraduate teaching obligations to the state and region. Increasingly it will be true that these service and teaching obligations cannot be met unless the University cultivates excellence in research and graduate education. We find no conflict among these basic obligations of the University, but it will fail to meet the most significant demands for undergraduate teaching and service at the levels of excellence the State deserves and requires unless it strengthens its research and graduate components.

**Table 3—Leading Ph.D.-granting Institutions in the Arts, Sciences, and Engineering, according to Data in the *Assessment of Research-Doctorate Programs in the United States***
(Number of programs in each field with standard scores of 60 or higher in reputation for "faculty quality")

| *Rank Order* | *Institution* | *Phys. Sci., Math* | *Hum.* | *Eng.* | *Biol.* | *Soc. Sci.* | *Programs rated 60 or higher* | *Programs rated 70 or higher* | *TOTAL SCORE* |
|---|---|---|---|---|---|---|---|---|---|
| 1 | U. of California (Berkeley) | 6 | 9 | 4 | 4 | 7 | 30 | 15 | 45 |
| 2 | Stanford U. | 6 | 4 | 4 | 4 | 6 | 24 | 10 | 34 |
| 3 | Harvard U. | 5 | 5 | - | 4 | 6 | 20 | 12 | 32 |
| 3 | Yale U. | 6 | 7 | - | 6 | 6 | 25 | 7 | 32 |
| 5 | MIT | 5 | 2 | 4 | 3 | 3 | 17 | 12 | 29 |
| 6 | Princeton U. | 5 | 7 | 4 | - | 5 | 21 | 7 | 28 |
| 7 | U. of Chicago | 5 | 4 | - | 4 | 7 | 20 | 7 | 27 |
| 8 | UCLA | 5 | 5 | 2 | 6 | 6 | 24 | - | 24 |
| 8 | U. of Michigan | 2 | 6 | 3 | 4 | 6 | 21 | 3 | 24 |
| 8 | U. of Wisconsin (Madison) | 5 | 3 | 2 | 5 | 6 | 21 | 3 | 24 |
| 11 | Columbia U. | 5 | 6 | - | 4 | 6 | 21 | 2 | 23 |
| 11 | Cornell U. | 6 | 6 | 3 | 4 | 3 | 22 | 1 | 23 |
| 13 | U. of Illinois (Urbana) | 4 | 2 | 4 | 4 | 3 | 17 | 2 | 19 |
| 14 | U. of Pennsylvania | 2 | 5 | 1 | 3 | 5 | 16 | 1 | 17 |
| 15 | Caltech | 4 | - | 4 | 1 | - | 9 | 6 | 15 |
| 16 | U. of Minnesota | 3 | - | 2 | 2 | 4 | 11 | 2 | 13 |
| 16 | U. of Texas (Austin) | 3 | 3 | 3 | 2 | 2 | 13 | - | 13 |
| 18 | U. of North Carolina (Chapel Hill) | 2 | 3 | - | 2 | 4 | 11 | - | 11 |
| 18 | Northwestern U. | 1 | 1 | 3 | 1 | 5 | 11 | - | 11 |
| 20 | U. of Washington (Seattle) | 2 | - | 1 | 5 | 2 | 10 | - | 10 |
| 21 | U. of California (San Diego) | 2 | 2 | - | 3 | 1 | 8 | - | 8 |
| 21 | Indiana U. (Bloomington) | 1 | 4 | - | - | 3 | 8 | - | 8 |
| 21 | New York U. | 1 | 4 | - | 1 | 1 | 7 | 1 | 8 |
| 21 | Rockefeller U. | 1 | - | - | 4 | - | 5 | 3 | 8 |
| 25 | Brown U. | 1 | 3 | 1 | - | 2 | 7 | - | 7 |
| 25 | Duke U. | - | - | - | 5 | 2 | 7 | - | 7 |
| 25 | Purdue U. | 2 | - | 4 | 1 | - | 7 | - | 7 |
| 28 | CUNY Graduate School | - | 3 | - | - | 3 | 6 | - | 6 |
| 28 | U. of Virginia | - | 3 | - | 1 | 1 | 5 | 1 | 6 |
| 30 | Carnegie-Mellon U. | 1 | - | 2 | - | 1 | 4 | 1 | 5 |
| 30 | Johns Hopkins U. | - | 1 | 1 | 1 | 2 | 5 | - | 5 |

neither of which has, as distinguished universities go, a wide range of professional schools, are likely to be rated higher than they would be if professional schools were counted too. Other institutions with many well-regarded professional schools, as evidenced by the two Blau/Margulies studies of the mid-1970s, are likely to rank lower than they otherwise would; these include Columbia and Ohio State University.

Third, the *Assessment* includes only thirty-two of the largest disciplines—largest in terms of how many Ph.D.'s have been conferred in recent years—and omits many of the smaller ones. Those it omits, to mention only ones covered by the Roose/Andersen study, include Russian, astronomy, developmental biology, population biology, entomology, and pharmacology. The *Assessment* also omits many interdisciplinary departments, committees, and programs. These include some exceptionally strong programs, such as the University of Pennsylvania's department of history and sociology of science, Columbia's department of East Asian languages and cultures, and the University of Chicago's committee on social thought.

So the aggregate figures should not be taken to reflect the universities' strength, across the board, in graduate education, but rather their strength in Ph.D.-granting programs in the arts, sciences, and engineering in those disciplines that have recently granted

INDIANA UNIVERSITY

GRADUATE SCHOOL

OFFICE OF THE DEAN
Kirkwood Hall, Room 111
Bloomington, Indiana 47405
(812) 335-9343

cc: JS
LK
AH
US

May 29, 1984

Attn: Robert T. Holt
Dean of the Graduate School
University of Minnesota
101 Pleasant Street, SE
Minneapolis, MN 55455

Dear Dean Holt:

We are enclosing a copy of "Integrity in Graduate Study: A Graduate School Guide." These are the guidelines we promised at the C.I.C. Graduate Deans' meeting in Evanston to send to you. Already distributed to Indiana chairpersons and graduate advisors, the "Guide" will go to all graduate students and graduate faculty in the fall.

Sincerely,

Sheila Cooper

Sheila M. Cooper
Special Assistant to the Dean

SMC:jep
Enc.

INTEGRITY IN GRADUATE STUDY: A Graduate School Guide

## Introduction

The question of integrity in scientific research is one which has received considerable attention not only in academic circles but also in the news media. A few notorious cases of fraud have recently made all of us in higher education especially sensitive to our vulnerability on this issue. These cases, largely in the sciences, have often come to light when attempts to replicate some of the work have failed. In the social sciences and to a larger degree the humanities a second problem, that of plagiarism, assumes greater prominence. A third area is that of cheating, which in the case of qualifying examinations pertains only to graduate students. A fourth, often a murky area in which the integrity of graduate study is open to criticism, involves abuses of confidentiality. And finally, a fifth area is that in which conflicts of interest arise in relationships between faculty members and students.

Although the ethical decisions involved in maintaining integrity in their work may seem very clear to some graduate students, they may not appear to be so clear to others, and some, possibly very few, may not even be aware that there is a potential for problems with integrity in research. For these reasons and to help its constituent units in the event that fraud, plagiarism, cheating, abuses of confidentiality, or conflict of interest should arise, the Graduate School has prepared these guidelines.

## Fraud

Fraud usually involves the student's intentional and deliberate misuse of data in order to draw conclusions that may not be warranted by the evidence. Falsification of results generally takes one of two forms: (1) the sheer fabrication of data, or (2) the fraudulent omission or concealment of conflicting data for the purpose of misleading other scholars. An intermediate form, difficult to detect especially in quantitative analyses, occurs when students are sloppy about categorization. All researchers, irrespective of discipline, can agree that the sheer fabrication of data is fraudulent, and all scientists, as well as most social scientists and humanists, can agree that the deliberate omission of conflicting data is also fraudulent. But a few social scientists and many humanists might argue that one person's conflicting data is another person's irrelevant data. In general, in these latter disciplines, the best researchers are those who come to terms with any piece of evidence that others may regard as conflicting. Strong support for a given hypothesis involves disposing of or dealing with alternative hypotheses.

The best insurance against fraud in graduate student research is, of course, the careful and close supervision of the faculty advisor as well as the examples of other members of the academic community. The student should communicate regularly and frequently with his or her major professor. He or she can do so in a variety of ways--by submitting laboratory notebooks for frequent review by faculty, by having faculty monitor the student's reading in the field, by regular updating of the faculty advisor on one's progress, or a combination of these or some other. Such communication will help the student develop intellectually and lessen the possibility of fraud. If a student is suspected of fraud, the academic community should handle the matter forthrightly but always with a clear regard to the rights of the graduate student so that the career of a student researcher who may be innocent is not damaged. Similarly, if graduate-student fraud is verified, it must be adjudicated in accordance with those procedures outlined in the Students' Bill of Rights and the Faculty Handbook.

## Plagiarism

Unlike fraud, which is usually the deliberate creation of false data, plagiarism is the use of another's words, ideas, or creative productions which are then passed off as one's own without proper attribution (giving due credit to the original source). Flagrant cases of plagiarism, which like fraud fortunately occur seldom, may involve the extensive use of others' articles, books, or creative productions with perhaps only slight modifications. The penalties here are usually very severe for the student and would likely result in expulsion from Graduate School or, if a degree has already been earned, rescinding of that degree. Less extensive cases of plagiarism can be either intentional or unintentional (just plain carelessness or ignorance of the commonly accepted rules). In general, one must cite one's authorities in the text or, more commonly, in the footnotes and use either direct quotations or skillful paraphrasing for all ideas that are not one's own. Since much of the basic information about our disciplines comes from outside ourselves through a variety of sources common to all who work in a discipline, it is of course unnecessary to footnote those facts and ideas which are, so to speak, in the common domain of that discipline. Otherwise, we would be footnoting everything we know. But an intimate familiarity with the literature of the discipline, or a subdiscipline thereof, lets one know when the distinctive words or ideas of another researcher should be given proper attribution. The fairly common practice among natural scientists of citing the previous significant literature relating to the subjects of their articles or books serves as something of a safeguard against plagiarism which is frequently not present in some social sciences and most arts and humanities disciplines.

Every graduate student who works with graduate faculty should have a comprehensive knowledge of what constitutes plagiarism. Ignorance of the concept of plagiarism on the part of the student is no excuse for resorting to it at the graduate level, if indeed ignorance is an excuse at the undergraduate level. Graduate students, if in any doubt about the concept, should discuss plagiarism with faculty members. And students should expect faculty members and departments to demand that they know what constitutes plagiarism.

There are problems, however, not always associated with traditional perceptions of plagiarism. One of these is the danger, when borrowing from the works of others, of quoting, paraphrasing, or summarizing the material in such a way as to misrepresent what the author is trying to say. A second problem arises when a student is overly dependent on the work of another, even if the other is cited meticulously. Still another problem is plagiarizing oneself by submitting the same data or findings in more than one article or by reviewing the same book in two different journals. And, finally, there is the problem of a graduate student's findings being used by his or her mentor without proper attribution to the student either in the article or book, indeed of not giving credit for joint or co-authorship in articles or books where a substantial amount of the work is done by the student. The student should discuss any perceived problem of this nature with the faculty member involved, the chair of the department, or, if need be, the Dean of the Graduate School.

In nearly all of these instances of plagiarism, or variations thereon, the best preventive is the example and consultation of the faculty advisor and the rest of the academic community who are sensitive to all of these nuances. Again, as with cases of fraud, Indiana University should handle any suspicion of plagiarism with due regard to the student's rights, and any detection of plagiarism should be adjudicated in accordance with those procedures outlined in the Students' Bill of Rights and the Faculty Handbook.

## Cheating

Cheating at the graduate level may not differ morally from the same action on the undergraduate level, but many find graduate cheating more reprehensible and the consequences, understandably, more severe. Academic dishonesty for one whose presence in graduate school declares he or she has opted for the intellectual life is a serious matter indeed. While cheating in the classroom is covered by regulations emanating from other parts of the University, cheating on qualifying or preliminary examinations is not. At the very least such dishonesty, once proven, should result in failure of the examination.

## Abuses of Confidentiality

Abuses of confidentiality by graduate students can take various forms. One example is that in which students have access to data or unpublished papers--or, in the case of natural scientists, grant proposals--of other graduate students or faculty members which they then use in their own research without permission, even though proper attribution may be made. Another example of the abuse of confidentiality is that--often in the arts, the humanities, and the social sciences--in which the graduate student gains archival or library materials about living or recently living subjects and uses them in his or her research without permission from the library or archive or in some cases from the individual. A biological and medical science student also must address himself or herself to the issue of research on live subjects.

In some ways confidentiality is one of the forms of integrity which is relatively easy to abuse and relatively difficult to detect. Once again, as with fraud and plagiarism, the example of the graduate student's mentor and that of the rest of the academic community is the best preventive.

## Conflicts of Interest

Genuine conflicts of interest between graduate students and faculty members can arise in a variety of ways. We have already alluded to the problems that can occur when the research of a graduate student is inadequately acknowledged by faculty either by failure to footnote properly or to give co-authorship credit. But another set of professional interpersonal relationships must be handled with great care if the integrity of graduate study is to be preserved. As continuing formal education becomes more common and as academics begin to become involved in the world of business, the possibility of a business relationship between student and teacher becomes greater. All of us are familiar with the kind of conflict of interest that may arise through nepotism, that is, when a person serves in an administrative or supervisory relationship to those who are related to him or her by blood or marriage. Most universities have rules which try to regulate professional relationships in such cases. Many faculty members are reluctant to have their own sons, daughters, or spouses take their courses for credit on the grounds that such students may be perceived by others to have an unfair advantage. A business relationship including a consulting one must evoke the same kind of caution.

Similarly, a student should not date an instructor while the student is enrolled in the instructor's course. And, of course, it goes without saying that a student should not ask any instructor to serve as his or her thesis or dissertation director (or research committee member) if the student is having or has had either an intimate personal relationship, a family relationship, or a business relationship with that instructor. If such a relationship should develop after a professional one has been established, the student should expect the instructor to remove himself or herself from the professional role. Such a relationship, whether between a graduate student and a faculty member or between a graduate student acting as an associate instructor and an undergraduate, constitutes a potential conflict of interest, especially as perceived by other students and faculty members, and, therefore, should be scrupulously avoided.

ATTACHMENT TO GRADUATE FACULTY COMMITTEE MINUTES OF SEPTEMBER 11, 1984:

FROM: Stephen C. Hedman, Acting Assistant Dean, Graduate School SCH

At the last meeting of the Duluth Graduate Faculty Committee, certain questions were raised regarding the selection of Director of Graduate Studies, Policy and Review Council Representatives, and membership on the Duluth Graduate Faculty Committee. Based upon the Graduate School Constitution and discussions with Graduate School Administration, the following appears to be the appropriate guidelines.

1. Directors of Graduate Studies (DGS): This individual will be designated by the graduate faculty of a graduate program. The graduate faculty involved in this may come from different departments. The term of service for the DGS will be three years.

2. Policy and Review Council Representative: This individual will also be designated by the graduate faculty of a graduate program. Each graduate program is entitled to one representative. The term of service will be three years. This representative does <u>not</u> necessarily have to be the same individual who serves as DGS.

3. Membership on the Duluth Graduate Faculty Committee (GFC): Each group of UMD graduate programs served by a specific Policy and Review Council is entitled to not more than two members on the Graduate Faculty Committee. The constitution does permit up to three members from UMD graduate programs served by the Social Sciences Policy and Review Council. These members are to be elected by the graduate faculty of the various programs. Historically, a Graduate Faculty Committee member also served as a Policy and Review representative, and this would appear to be the intent of the Graduate School Constitution. Consequently, the programs served by a specific Policy and Review Council should elect its Graduate Faculty representatives from among its Policy and Review representatives. This, of course, has the advantage of having Graduate Faculty Committee members who are familiar with graduate policies and procedures. However, if we strictly followed this procedure, then we would have a very small number of possible Graduate Faculty Committee members due to the small number of our graduate programs. Our election of Graduate Faculty Committee members would become only a mere formality; a situation which is probably not good. Therefore, it has been determined that an individual could be elected as a Graduate Faculty Committee member without also having to be a Policy and Review representative. In fact, this Graduate Faculty Committee member need not even be a Director of Graduate Studies. At this time it is not clear the extent to which this "exception" (a Graduate Faculty Committee member who is not a Policy and Review representative) would or should be allowed. At the next meeting of the Executive Committee of the Graduate School, this issue will be raised and, hopefully, a more definitive policy be established.

The above comments will <u>not</u> affect current Directors of Graduate Studies, Policy and Review representatives, or the 1984-85 composition of the Graduate Faculty Committee. They may, however, become significant in future elections for these positions.

V F

UNIVERSITY OF MINNESOTA
TWIN CITIES

Office of the Dean

Graduate School
Johnston Hall
101 Pleasant Street S.E.
Minneapolis, Minnesota 55455-0421

5 October 1984

Professor John L. Sullivan
Chair, Senate Committee on Research
Department of Political Science
1414 Social Sciences Building
West Bank Campus

Dear John:

I believe the Senate Committee on Research, which you currently chair, last year began to discuss the need for University guidelines governing honesty in research. Simultaneous with your committee's consideration of this issue, discussions on the same topic were under way in the Graduate School.

I enclose the recommendations of the Graduate School's Health Sciences Policy and Review Council concerning an institutional policy on integrity in research. These recommendations were discussed at a meeting of the Graduate School Executive Committee in June 1984, with the result that I am to consult with the chair of the Senate Committee on Research to determine which committee should take the initiative in drafting an all-University policy. I think there are several possibilities; for example, the Graduate School may simply wish to review guidelines formulated by the Senate Committee before they are adopted, or conversely, your committee may want to look over a draft policy recommended by the Graduate School. Another, perhaps more efficient, way of proceeding would be to have one group serve in a consultative role during the drafting period to ensure that the concerns of both committees are reflected in the guidelines. Other individuals--for instance, representatives from the Office of Research Administration and the University Attorney's Office--could also be included in an advisory role during the drafting process, as recommended in the attached statement.

The Association of American Universities Committee on the Integrity of Research, and the Association of American Medical Colleges, have developed guidelines to aid colleges and universities in writing institutional policies dealing with honesty in research. I am also enclosing these for your information, although you may well already have them.

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Anesthesiology
Medical School
B515 Mayo Memorial Building, Box 294
420 Delaware Street S.E.
Minneapolis, Minnesota 55455
(612) 373-8826



cc JS
KZ
AH
MS
VVF

March 12, 1984

Robert T. Holt, Ph.D.
Dean, The Graduate School
321 Johnston Hall
101 Pleasant Street, S.E.
Minneapolis, MN 55455-0421

Dear Dean Holt:

In compliance with a recent communication from your office, this letter is my official request that the undesignated M.S. degree (requiring a minimum of two years) be deleted from the offerings of this department. I wish only to list the M.S. Anes. degree (requiring a minimum of three years) as the only graduate degree available from this department.

This change is consistent with the revised program description to be published in the Graduate School Bulletin 1984-86.

Sincerely yours,

JJBuckley

Joseph J. Buckley, M.D.
Professor and Head

JJB:tcw

cc JS MS
KZ WF
AH

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Dermatology
Box 98 University Hospitals
420 Delaware Street S.E
Minneapolis, Minnesota 55455
(612) 373-8720



March 9, 1984

Robert Holt, Dean
Graduate School
321 Johnston Hall

Dear Dean Holt:

It has come to our attention the the Department of Dermatology has for years offered an M.S. degree, which requires a minimum of two years training. This program is in addition to the program leading to the M.S. Derm degree, which requires a minimum of three years. We no longer wish to offer this undesignated M.S. degree, but we do wish to continue offering the M.S. Derm degree.

Please let us know if there is any further question about this matter.

Sincerely,

Robert W. Goltz, M.D.
Professor and Head
Department of Dermatology

RWG:af
cc/ Wendy Larson

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Spanish and Portuguese
34 Folwell Hall
9 Pleasant Street S.E.
Minneapolis, Minnesota 55455
(612) 373-7998



cc JS DC
KZ WF
AH DM
MS

January 16, 1984

To: Robert Holt, Dean, Graduate School
Fred Lukermann, Dean, College of Liberal Arts

From: Faculty of Hispanic Linguistics

Subject: Hispanic Linguistics (HL) Faculty compliance with the order to terminate the HL Ph.D. Program.

The decision of the Deans of the Graduate School and of the College of Liberal Arts to terminate the HL Ph.D. Program was announced by the Deans at the January, 1983 meeting and restated in the Deans' memoranda of February 8, June 6, and October 24, 1983.

The HL Faculty has complied with the Deans' request (cf. memo, Oct. 24, 1983), that the HL Ph.D. Program be terminated by the end of fall quarter, 1983.

cc: Dean Russell Hamilton, College of Liberal Arts
Professor Larry Hutchinson, Linguistics
Professor Hernan Vidal, Spanish & Portuguese
Dean Kenneth Zimmerman, Graduate School

Office of the Dean

UNIVERSITY OF MINNESOTA
TWIN CITIES

Graduate School
Johnston Hall
101 Pleasant Street S.E.
Minneapolis, Minnesota 55455

October 24, 1983

TO: Graduate Faculty, Hispanic Linguistics

FROM: Robert Holt, Dean, Graduate School
Fred Lukermann, Dean, College of Liberal Arts

SUBJECT: Hispanic Linguistics Ph.D. Program

We believe that the points made in our June 6 memorandum still stand and, having conferred with one another once again, we ask that you make formal arrangements to discontinue the doctoral program. Standby status has merit for a period of a year or so but not on the extended basis you seek. Our best estimate is that conditions will not become favorable in the near future.

We are pleased to hear of your support to continue the M.A. portion of the graduate program.

We ask, therefore, that you seek disestablishment of the Ph.D. program before the end of fall quarter so that this matter can be acted upon by the Language, Literature and Arts Policy and Review Council and the Executive Committee of the Graduate School during winter quarter 1984.

Thank you for your help.

RH:FL:dks

cc: Dean Russell Hamilton
Professor Larry Hutchinson
Dean Craig Swan
Professor Hernan Vidal
Dean Kenneth Zimmerman

cc AH LH
BH DC
MS
8/29/83



UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Spanish and Portuguese
34 Folwell Hall
9 Pleasant Street S.E.
Minneapolis, Minnesota 55455

(612) 373-7998

August 24, 1983

To: Robert Holt, Dean, Graduate School
Fred Lukermann, Dean, College of Liberal Arts

From: Faculty and Students of Hispanic Linguistics

Subject: Proposal for a Suspension of the Hispanic Linguistics Ph.D. Program

Faculty and students of Hispanic Linguistics agree that the Hispanic Linguistics M.A. should be retained as recommended by the Deans of the Graduate School and College of Liberal Arts. They propose, however, a suspended status of the Hispanic Linguistics (HL) Ph.D. rather than a termination as decided by the Deans, (cf. Deans' memorandum of June 6, 1983).

Several factors favor the consideration of an extended suspension of the HL Ph.D. Foremost among them is the substantive prominence of the HL disciplines, responding as they currently are to a vast and growing Spanish and Portuguese speech community, not only in this country but in much of the hemisphere and many parts of the world. Substantial initiatives have been taken by several universities centered primarily in the U.S. to develop HL research and doctoral training programs in response to the expanding needs of that speech community.

Prior to the suspension of graduate student recruitment, the primary goal of the HL Ph.D. program at Minnesota was to form a decisive part of those nationwide initiatives with a sizeable contribution through its established and relatively early start in the field. By discontinuing the HL doctoral program, Minnesota is relinquishing an opportunity to participate in a period of conspicuous development in the discipline.

It is the view of the HL program members that an inactive, 'standby' status rather than termination of the HL Ph.D. would facilitate early reactivation in the event future conditions should favor such action. In the interim, the HL M.A., as the surviving constituent of the HL graduate program, can continue to provide an essential foundation and orientation to HL graduate studies.

cc: Dean Roger Benjamin, College of Liberal Arts
Dean Russell Hamilton, College of Liberal Arts
Professor Larry Hutchinson, Linguistics
Professor Hernan Vidal, Spanish & Portuguese
Dean Kenneth Zimmerman, Graduate School

Office of the Dean

UNIVERSITY OF MINNESOTA
TWIN CITIES

Graduate School
Johnston Hall
101 Pleasant Street S.E.
Minneapolis, Minnesota 55455-0421

June 6, 1983

TO: Hispanic Linguistics Faculty

FROM: Robert Holt, Dean, Graduate School
Fred Lukermann, Dean, College of Liberal Arts

SUBJECT: Hispanic Linguistics Ph.D. Program

We have now thoroughly explored the matter of a Romance Linguistics doctoral program as a possible solution to the impasse surrounding the Hispanic Linguistics doctoral program. At the present time the faculty and budgetary resources are simply not available to support an extended program in Romance Linguistics. We believe the idea should continue to be explored over the next several bienniums when and if the fiscal picture in the College of Liberal Arts improves.

In the meantime the consequences for the Hispanic Linguistics doctoral program, we regret to say, are negative. We ask, therefore, that at the start of fall quarter you take steps to discontinue the Ph.D. program through the governance structure of the Graduate School for the reasons we have discussed before: erosion in critical mass of graduate faculty, dwindling attendant support, etc. The suspension of admissions to the Ph.D. program will remain in effect until the process of disestablishment is complete. We believe there is merit in retaining the M.A. in Hispanic Linguistics and so recommend. However if you have reason to believe that holding on to the M.A. degree is not a wise course of action, please contact us so that we reach a common point of view on this aspect of the overall matter.

The Ph.D. program in Hispanic Linguistics has served a vital purpose in its years of existence, made all the more valuable by the dedicated efforts of those of you closely associated with it. We are appreciative that these accomplishments were possible. Your continued cooperation in effecting the present transition will be no less appreciated.

RH/FL:wsl

cc: Dean Roger Benjamin, College of Liberal Arts
Dean Russell Hamilton, College of Liberal Arts
Professor Larry Hutchinson, Linguistics
Professor Hernan Vidal, Spanish & Portuguese
Dean Kenneth Zimmerman, Graduate School

February 8, 1983

MEMORANDUM

TO: The Hispanic Linguistics Faculty--Professors Kathleen Houlihan, Lawrence Mantini, Sandra Pinkerton, and Ronald Sousa

FROM: Robert T. Holt

SUBJECT: Hispanic Linguistics Program

After extended discussions with Deans Lukermann, Benjamin and Hamilton it appears obvious that there is no support in the administration of the College of Liberal Arts for a Ph.D. program in Hispanic Linguistics. Discussions are continuing, however, on the possibility of an extended program in Romance Linguistics. Some decision should be made before the end of the spring quarter 1983.

Because there is no support in the College of Liberal Arts administration for the Hispanic Linguistics program leading to a Ph.D., I am continuing the suspension of admissions.

I concur with the decision made by the Deans in the College of Liberal Arts that it would not be wise to try to staff a program in Hispanic Linguistics; but I am in support of the idea of developing a program in Romance Linguistics if resources are available to build a first class program. I have no sympathy, however, with trying to develop a program on a shoe string; any new graduate program at the University of Minnesota is going to have enough resources to be a first class program that can command national attention or there will be no program at all.

RTH:mt

cc: Dean Fred Lukermann
Dean Roger Benjamin
Dean Russell Hamilton
Professor Hernan Vidal

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Microbiology
Medical School
1460 Mayo Memorial Building, Box 196
420 Delaware Street S.E.
Minneapolis, Minnesota 55455

GRADUATE SCHOOL
SEP 6 1983
OFFICE OF THE DEAN

August 30,1983

Dean Robert Holt
Graduate School
Johnson Hall

Dear Dean Holt:

The Graduate Faculty in Microbiology have developed a new Plan B Master of Science degree called Microbial Engineering. Please find enclosed four copies of Sections I, II, and III of the proposal developed in accordance with the directive issued by the Office of V.P. for Academic Affairs.

We have distributed the program to a tentative list of Graduate Faculty in a number of disciplines. Those Faculty listed in Section III, Appendix B of the enclosed proposal have sent letters of approval and wish to serve as members of a new Graduate Faculty program.

Please review this proposal for us and then let us know when we may have the V.P. of Academic Affairs review it for all of us.

We will be glad to send the required 40 or so copies when the entire package is ready for review by the Regents.

Please call on me or members of our committee if you have questions or would like to meet with us.

Sincerely,

Palmer Rogers

Palmer Rogers, PhD
Chairman, Committee on MS Program
in Microbial Engineering
373-8120

Committee Members

| | | |
|---|---|---|
| Dr. Martin Dworkin | Dept. of Microbiology | 3-8048 |
| Dr. Peter Chapman | Dept. of Biochemistry | 3-1264 |
| Dr. Richard Hanson | Gray Freshwater Biological Institute | 471-8476 |
| Dr. Larry McKay | Dept. of Food Science & Nutrition | 3-1408 |
| Dr. Anthony Faras | Dept. of Microbiology | 3-8147 |
| Dr. Arnold Fredrickson | Dept. of Chem Engineering | 3-2312 |

UNIFORM PROGRAM INVENTORY AND PROPOSAL FORM

SECTION I
Program Proposal Abstract and Cover Sheet
(See Attached Instructions)

1 Unit, Campus or College University of Minnesota, Twin Cities Code No. ______

## I. General Information

A. Program Title Microbial Engineering, M.S.

B. Program Review Category: (check one) X Regular
___ Experimental (If Experimental, give Reporting Date: ___/___ ___)

C. Proposed Implementation Date: 9 / 15 / 84

D. Program Length: Total Cr/hr 44-60 Classroom 30-46 Laboratory 14

E. Administrative Unit Immediately Responsible for Program: Graduate School.

F. Describe the Program (in 50 words or less):

The Masters of Science degree in Microbial Engineering is a two-year program
2 of advanced study designed to prepare men and women in the application of the
basic science of microbiology to the biotechnology industry. Study includes
3 advanced laboratory and lectures in modern microbial methods, chemical
engineering and computer proficiency. All students will do a preceptorship
4 in local biotechnology companies and develop a research paper.

5 G. Expected student interest in the program during the first year of operation, and when the program reaches full operating level:

| | First Year: 1984-85 (Yr.) Number (Headcount) Expected | Student Credit or Contact Hours | Full Operation: 1985-86 (Yr.) Headcount Capacity | Student Credit or Contact Hours |
|---|---|---|---|---|
| a. Enrollment Program Enrollees | 4 x22 | 88 | 12 x22 | 264 |
| Other Students | 8 x16 | 128 | 16 x16 | 256 |
| Total | 12 | 216 | 28 | 520 |
| b. Program Graduates/ Completors | | | 4/6 | 176/264 |

FORM NO. 25

II. Budget Data

6 A. Projected Costs of the Program:

7

| | First Year 1984-5 | | | | Full Operation 1985-on | | | |
|---|---|---|---|---|---|---|---|---|
| | New | | Re-assigned | | New | | Re-assigned | |
| | No. FTE | Annual Cost | No. FTE | Annual Cost | No. FTE | Annual Cost | No. FTE | Annual Cost |
| a. Faculty | -. | $ - | .5 | $ 27,900 | .5 | $ 22,200 | .5 | $ 27,900 |
| b. Civil Service | -. | $ - | .5 | $ 7,259 | .5 | $ 7,259 | .5 | $ 7,259 |
| c. Equipment, Supplies, etc. | | $ 2,000 | | $ 2,000 | | $ 2,000 | | $ 2,000 |
| Total Direct Costs (a+b+c) | | $ 2,000 | | $ | | $ 31,459 | | $ |
| d. One-time Costs | | $ | | $ | | $ | | $ |
| e. Space Rental | | $ | | $ | | $ | | $ |
| f. Indirect Costs | | $ | | $ | | $ | | $ |
| g. Total Program Costs (a+b+c+d+e+f) | | $ 2,000 | | $ 37,159 | | $ 31,459 | | $ 37,159 |

8 B. Expected Sources of Funds for Program:

9

| | First Year: 1984-5 | | | Full Operation: 1985-on | | |
|---|---|---|---|---|---|---|
| | Dollar Amount | % of Annual Expend. | One Time Input | Dollar Amount | % of Annual Expend. | One Time Input |
| a. Local | $ | . | $ -0- | $ | . | $ |
| b. State | $ 39,159 | . | $ -0- | $ 68,618 | . | $ -0- |
| c. Tuition | $ | . | $ | $ | . | $ |
| d. Federal | $ | . | $ | $ | . | $ |
| e. Private | $ | . | $ | $ | . | $ |
| f. Dedicated Fees | $ | . | $ | $ | . | $ |
| g. Other (Specify) | $ | . | $ | $ | . | $ |
| h. Total | $ 39,159 | 1.3 | $ -0- | $ 68,618 | 1.96 | $ -0- |

10 C. If there are any formal arrangements with other institutions or agencies, (e.g. clinical sites, cooperation, joint programs) explain, giving names of institutions: ______

D. System Verification:

8 ______ 15 ______ 22 ______

______ Authorized Institution or System Signature ______ Title ______ Date

29 ______ 39 ______ 40 ______ 42 ______ 47

# Section II

Program Title: Master of Science Degree in Microbial Engineering

## 1. Summary Description of the Program

Objective: The Master of Science degree in Microbial Engineering is designed to prepare men and women in the integrated use of the basic science of microbiology for technologic applications of the capacities of microorganisms and other cell systems.

The Curriculum for the MS degree (Plan B) in Microbial Engineering.

Course Work. Courses taken during the two year program will depend upon the interests and competence of the student. They include microbiology and biology courses in advanced microbiology laboratory, recombinant DNA laboratory, hybridoma and monoclonal antibody laboratory, industrial microbiology, microbial genetics, and immunobiology. Intermediate chemical engineering courses in principles, unit operations and separation, and biochemical engineering are required. Students will choose a supporting program of a few special courses in food science, genetics, pharmacognosy, or biochemistry.

Preceptorships in Microbial Engineering. A cooperative venture with local biotechnology companies.

Students will carry out two 6 week preceptorships or one 10-12 week preceptorship usually during the summer session between the two resident years. Options include research and development or pilot and production work in local participating biotechnology companies. Applied research in a graduate faculty laboratory is also an option. All students must have experience on modern computer-controlled experimental fermenters.

Plan B Project. Each student will prepare an in depth research paper based upon evaluating and analyzing the application of basic microbial research to technical development and production of products. This paper will develop from one of the preceptorships.

Seminars. Students will present two seminars related to biotechnical aspects of their plan B project and participate in a program of invited lecturers and colloquia during the second year of study.

Computer Proficiency. Students are required to show evidence of competence in using computers and a practical working knowledge of one computer language.

Laboratory Teaching. Advanced students will each instruct in one laboratory course offered to new Microbial Engineering students.

Final Written and Oral Examinations. Students will be required to pass both written and oral examinations prepared by the Graduate Faculty in Microbial Engineering.

Section II, continued

1. Summary Description of the Program, continued:

Prerequisites for admission: Normally applicants with a bachelor of arts or science degree in biological sciences, chemistry, or chemical engineering will be considered. Preparation includes one year each of calculus, organic chemistry, physics, microbiology and chemical engineering, and courses in physical chemistry, biology, genetics and biochemistry. Since backgrounds vary, deficiencies are completed during the first year. A grade average of B or better is required for admission.

Estimates of enrollees and graduates. The proposed time schedule for implementation indicates four graduate students in Fall 1984. June 1985 will commence preceptorships with local company involvement. Fall 1985 - Start second group of six graduate students and first group will begin second year to graduate June 1985. Class size will be limited to 6 students per year. Expansion would depend on perceived job demand and government and/or industry support for students and program.

Resources for the Microbial Engineering Program. University resources will include time and effort from graduate faculty members in Microbial Engineering. Thirty-five Graduate faculty of 10 departments representing 5 colleges or institutes have agreed to serve on this graduate faculty administered by the Graduate School.

Time commitments to courses in this program have already been made by faculty members. New courses have already been running one or two years.

Only three courses have not been started or approved by the Graduate School.

MicB 82XX Preceptorship: Microbial Engineering. We have obtained commitments from two local companies and from Director of Freshwater Biology Institute for direction of students, space, and support.

MicB 8218 Advanced Immunology Laboratory. The change in this lab to Hybridoma and Monoclonal Antibodies must be approved. Two faculty have tentatively offered to devote time to development of this lab. No firm committed faculty as yet.

(Biol) ___ Biofermentation Laboratory. Not yet developed. Will be on line by June 1985 when the director and faculty for the new Biological Processing Technology Institute are here as part of the Biotechnology Center.

Other support and resources.

We will depend heavily upon the resources of the Dept. of Microbiology, Medical School for two important resources:

Laboratory space and assistance for teaching laboratory courses for this program. Students from other programs also participate - so this will be an increase in on-going effort.

Office-secretary and supplies to administer the program. Temporarily space is available but the staff must be enlarged.

We will depend upon the Institute for Advanced Studies in Biological Process Technology for providing equipment for advanced training on modern fermenters and separation equipment. The Biotechnology Center will work closely with us for student training.

Local biotechnology companies will provide space and instruction of advanced students for the preceptorship portion of their training. Some companies will provide financial support to students during their full time work period with their R and D laboratories.

Section II, continued

2. Need for the Program.

a. New Knowledge: Basic research on the bacteria, the viruses, other microorganisms and on immune mechanism has led directly to the emergence of powerful new research tools such as the recombinant DNA and the hybridoma-monoclonal antibody technologies. These and other innovations in microbiology have led to a revolution in biology analogous to the development of the transistor and microcircuitry on the electronics and computer industries. The intellectual, philosophical, and social impacts of these new discoveries are already evident from popular press coverage and in the more serious essays and reviews in magazines and periodicals available to all of us.

b. Commercialization and Jobs: These advances in microbiology centered on biotechnology research have proliferated to a point where a recent issue of "Genetic Engineering News" lists over 125 new companies and new divisions of traditional companies actively pursuing research, development and production of new products mostly involving microbes and immunology.

These commercial developments and new industries have been a potent lure for research talent, especially, up to now, at the Ph.D. level. Both industry and academia are beginning to feel the effects of manpower shortages - not just among top research scientists, but in the ranks of support personnel. Qualified individuals with bachelors and masters degrees in applied and industrial microbiology specialties will continue to find jobs in biotechnology research and production facilities. These people must be professionals who know both basic and applied aspects of modern microbiology, who can take initiative, and who can work directly with top research staff.

c. Employment Prospects: Forecasters point out that there will be a need for 35,000 biotechnologists in the U.S. by the end of this century. The students who are trained in this program will have the expertise necessary to fill these positions.

Current advertisements for employees in scientific magazines already show a need. Letters collected from leading biotechnology companies concerning our program support the view that M.S. Graduates in Microbial Engineering are now and will be in demand. (See Section III).

d. Student Interest: Of 180 senior majors in Biology and Microbiology surveyed over the past two years, 44 seniors (24%) said they were very interested in pursuing a program such as this for advanced work and job preparation.

In addition, members of the Graduate Faculty have received numerous queries and questions about advanced training in industrial applications of microbiology from biology and chemical engineering students.

3. Mission

The University of Minnesota must respond effectively to the new and changing needs and challenges of our society. Here at the University of Minnesota we have recognized the importance of biotechnology and the new challenge is already being met. Recently, the Biotechnology Research Center, an all university center, has formed to identify and develop University resources for research and graduate programs. This new proposed program in Microbial Engineering is a vital part of the educational effort of the Center and the Graduate Faculty of the university to develop and offer a scholarly advanced program aimed toward new emerging areas of science and technology.

The proposed program responds to a need for developing well-trained microbiologists able to help build and man the new high technology industries utilizing biotechnology for production.

In responding to this need the University is venturing to cooperate with industries in Minnesota involved in bioprocessing and biotechnology research and development. At all levels: The Biotechnology Center, the new Institute for Advanced Studies in Biological Process Technology and in this degree program in Microbial Engineering-University faculty in 5 institutes and colleges are working as a team with industry management and scientists. This graduate program, as explained above, depends heavily upon cooperation between industry management and scientists. This graduate program, as explained above, depends heavily upon cooperation between industry scientists and University professors. Thus, this program exemplifies the three aspects of the University mission of teaching, research and service.

4. Comparative Program Analysis

University programs: There are no programs in Minnesota that fulfill the objectives of the proposed M.S. degree in Microbial Engineering.

At the University the Food Science M.S. program has one route of study, in which students emphasize the application of microbiology to the food industry. However, the Food Science program does not cover the general industrial thrust this program offers.

The Biomedical Engineering program is for PhD level study involving the interface of the medical sciences with the engineering disciplines.

Other U.S. institutions: There are about a dozen new programs centered at Universities in the entire country that remotely resemble this proposed one. These programs called variously applied molecular biology, biotechnology, biological engineering, genetic engineering, etc. are much like the program we propose here. The Center for Molecular Genetics at the University of Michigan is developing new programs in the B.S. and M.S. degree that are similar since this proposed Microbial Engineering Program will be closely allied with the Biotechnology Center here at the University of Minnesota.

Because this field is highly technical and strongly dependent upon new research findings in microbiology, immunology, and bioprocess engineering, we must argue in favor of a university based program like the other national programs at MIT, University of Michigan, University of Maryland, etc. Thus, training programs emerging in various technical institutes throughout the country were not covered or compared with the proposed advanced M.S. degree.

5. Duplication (None)

6. Cost/Benefit

Evaluation procedures: The quality control and ultimate detailed development of the program is the responsibility of the graduate faculty in Microbial Engineering. Thirty-five faculty are in agreement with the outline of the proposed program and will participate in it. The faculty will elect a Committee on Graduate studies consisting of a Director and 5 members to administer the program for students, cooperating industry and faculty. Changes and evaluations will be generated by this Committee.

The Policy and Review Council for the Health Sciences or other Council assigned by the Dean of the Graduate School will approve changes and evaluate progress of all aspects of the program.

The Dean of the Graduate School will schedule systematic reviews of the program as with other Graduate Programs of the University of Minnesota.

Social Benefits:

The major benefit of the proposed M.S. Program is to produce men and women with basic knowledge of microbial science and chemical engineering and familiarity with practical applications of this knowledge. These people will be well suited to modern industry developments in bioprocessing and biotechnology in Minnesota as well as the surrounding midwest.

A second social benefit is the cooperative arrangement with local industry for practical preceptorships and feedback into the entire Microbial Engineering program. We envision that a deepening mutual understanding of roles and an enhanced appreciation of goals by both University and Industry may be achieved as a result of carrying out this program.

Cost per Student:

Based upon the budget submitted, the cost per student is computed as follows:

First Year

| | |
|---|---|
| Budget | \$39,159 |
| less tuition paid by student (22 cr @ \$55/cr x 4) | 4,840 |
| | 34,319 |
| by 4 students = | \$6,080/student |

Second Year

| | |
|---|---|
| Budget | \$68,618 |
| less tuition paid by students (22 cr @ \$55/cr x 12) | 14,520 |
| | 54,098 |
| by 12 students = | \$4,508/student |

Section III

Microbial Engineering

Revised April 19th, 1983

Revised June 8th, 1983

Revised August 18, 1983

March 30, 1983

Proposal for: Master of Science Degree in Microbial Engineering.

Submitted by the: Graduate Faculty in Microbiology and Department of Microbiology.

of the: Graduate School.
Medical School. of the
College of Health Sciences.

| Approval Certification | Additional |
| --- | --- |
| 8/30/83<br>Head, Dept. of Microbiology — Date | Dean Graduate School — Date |
| 8/30/83<br>Director Graduate Studies Graduate Faculty Microbiology — Date | Vice President Health Sciences — Date |
| 8-31-83<br>for Dean, Medical School — Date | Approval by Regents — Date ______ |
| | 1st Read CAC ______ |
| Chairman Policy and Rev Committee, Health Sciences — Date | 2nd Read CAC ______ |
| | Recommend by MHECB ______ |
| VP Academic Affairs — Date | Confirm Regents ______ |

## A. Introduction.

Over the past two years the Department of Microbiology along with the entire graduate faculty of microbiology have had under serious discussion the rapidly changing and expanding role of the discipline of microbiology. We note that the basic research on the bacteria, the viruses, other microorganisms and on immune mechanism has led directly to the emergence of powerful new research tools such as the recombinant DNA and the hybridoma-monoclonal antibody technologies. These and other innovations in microbiology have led to a revolution in biology analogous to the development of the transistor and microcircuitry on the electronics and computer industries. The intellectual, philosophical, and social impacts of these new discoveries are already evident from popular press coverage and in the more serious essays and reviews in magazines and periodicals available to all of us.

Our deliberations, however, have centered primarily upon the greater role microbiology is having now in the development of new medically important therapeutic and diagnostic materials; of new plant varieties, plant growth regulators, and insecticides for agriculture; and of new sources of special chemicals for industry. These advances in microbiology centered on biotechnology research have proliferated to a point where a recent issue of "Genetic Engineering News" lists over 125 new companies and new divisions of traditional companies actively pursuing research, development and production of new products mostly involving microbes and immunology.

These commercial developments and new industries have been a potent lure for research talent, especially, up to now, at the Ph.D. level. Both industry and academia are beginning to feel the effects of manpower shortages - not just among top research scientists, but in the ranks of support personnel. Qualified individuals with bachelors and masters degrees in applied and industrial microbiology specialties will continue to find jobs in biotechnology research and production facilities. These people must be professionals who know both basic and applied aspects of modern microbiology, who can take initiative, and who can work directly with top research staff.

How are academic institutions meeting this new challenge? There are some beginnings and trends found in other academic centers detailed in part C below. At the University of Minnesota we have recognized the importance of biotechnology and the new challenge is already being met. Two formal seminars including faculty and local industry representatives were held in 1981 and 1982 on the twin cities campus. A scientific symposium Biological Basis of New Developments in Biotechnology sponsored by the Departments of Biochemistry and Microbiology of the Medical School together with the College of Biological Sciences, the College of Agriculture and Institute of Technology, was held in May 1982. Recently, the Biotechnology Research Center, an all university center, has been formed to identify and develop University resources for research and graduate programs.

In response to the above outlined emerging needs and thrusts in industry and at the University of Minnesota, the Graduate Faculty in Microbiology and the concerned Departments and colleges propose the Master of Science degree program in Microbial Engineering, outlined below.

B. The Proposed Program.

1. Objectives: The objective of this Plan B Master of Science degree is to prepare men and women in the integrated use of the basic science of microbiology with technological applications of the capacities of microorganisms, cultured cells, and parts thereof.

2. Admission requirements: Normally applicants with a bachelor's degree in biological sciences, biochemistry, chemistry or chemical engineering will be considered. Recommended academic preparation includes one year each of calculus, organic chemistry, physics, microbiology and basic chemical engineering and a background in basic biology, physical chemistry, biochemistry and genetics. Since backgrounds vary, deficiencies can be made up during the first year of graduate work.

For admission an undergraduate grade average of B or better is normally required.

Applicants for admission must include GRE Scores, three letters of recommendation, and an autobiographical statement including their occupational goals.

3. Summary Description of the Curriculum for the M.S. Degree in Microbial Engineering. (a) Course work is required in a specialized program of microbiology, molecular biology, and immunobiology designed to combine a depth of understanding of basic principles with a development of technical knowledge and know-how in industrial microbiology. Approximately two to four courses in intermediate level chemical engineering are required. (b) During the second year students will be assigned to preceptorships in area private company research laboratories. The (one or two) preceptorships are normally completed during the summer sessions after the first year.

(c) Students will complete one Plan B project based on a research project arising from the preceptorships.

(d) Students will present two seminars in a Biotechnology seminar series.
(e) Supporting courses (8 cr) may be chosen from specified fields including biochemistry, food science, genetic and cell biology, or pharmacognosy.
(f) Proficiency in programming and using at least one computer language must be demonstrated.
(g) Written and oral final examinations are required.
(h) Teaching experience
All students will assist in instruction in one basic laboratory course in advanced microbiology, molecular biology, or biofermentation.

4. Detailed description of the Curriculum for the MS (Plan B) degree in Microbial Engineering.

Assignment to Advisor
Prior to registration, new graduate students are assigned an advisor. The advisor assists the student in planning his/her two-year program and Plan B project. All entering students have the opportunity to change advisors, providing mutually satisfactory arrangements can be made.

B. continued.

Master's Degree Program Filing

A special form obtained from the Graduate School is used to outline the complete program to be offered for the M.S. Degree and to list the title of the Plan B Project to be submitted. This program is approved by the advisor and filed with the Graduate School no later than two quarters before graduation. The degree program form is submitted to the advisor for review, approved by the committee, and then filed with the Graduate School. Following the committee's approval, the student will record the outline of the program in the Student Progress File and xerox a copy of the program for his/her personal file in the departmental office. Early submission of the program is encouraged, and it may be presented after completing 9-15 graduate credits (at least three of which are in the major). A transcript accompanies the Master's program form.

Graduate School Requirements for M.S. Degree in Microbial Engineering Plan B.

The M.S. Degree in Microbial Engineering is offered only under Plan B. This includes satisfactory academic performance in the following:

(a) A minimum of 20 credits in the major field
(b) A minimum of 8 credits in a related field outside the major.
(c) Plan B Project
(d) Final written examination
(e) Final oral examination

The balance of the credits taken to meet the 44-credit minimum degree requirement will be chosen by the student and advisor.

Course Work

Courses to be taken for the student's two-year program will be determined by the advisor, and by the interest and competence of the advisee. Microbiology, Biology and Chemical Engineering courses or closely related courses comprise the major field requirements listed below. Students who have satisfactorily completed equivalent courses at the University of Minnesota or other institutions need not repeat course work.* The student should meet with his/her advisor concerning course work. A minimum of twenty (20) credits is required in the major field for graduation with an M.S. Degree in Microbial Engineering by the Graduate School. Most students will typically complete about 60 credits of work during the program. A list of required and supporting course work is shown below. Two typical chronologies for students entering with a B.S. in biology and chemical engineering follow.

---

* All courses appearing on the program must satisfy Graduate School transfer rules.

Major Courses:

Required of all Majors:

| | | | Credits |
|---|---|---|---|
| MicB | 5351 | Industrial Microbiology | 3 |
| MicB | 5106 | Advanced General Microbiology Laboratory | 3 |
| MicB | 5355 | Genetic and Molecular Aspects of Biotechnology | 3 |
| Biol. | 5125 | Recombinant DNA Laboratory | 4 |
| MicB | 8218 | Immunochemistry and Immunobiology | 3 |
| MicB | 8121 | (Hybridoma & Monoclonal Antibody)Advanced Immunology Laboratory | 2 |
| MicB | 8112 | Microbial Genetics | 3 |
| MicB | 8110 | Biology of Microorganisms | 3 |
| MicB | 5990 | Practicum: Teaching | 1 |
| MicB | 82__ | Preceptorship: Microbial Engineering | Cr. Arr.(4 cr. max) |
| MicB | 8910 | Seminar (Biotechnology) | 2 |
| ____ | ____ | Biofermentation Laboratory | ____(suggested) |
| ChEn* | 5104 | Unit Operations and Separation Processes | 4 |

*ChEn courses: One or two Quarters: 5104 or more advanced courses.

Other selected major courses:

| | | | |
|---|---|---|---|
| MicB | 5218 | Immunology (with lab) | 4 |
| MicB | 5424 | Virology (with lab) | 4 |
| MicB | 5232 | Medical Microbiology | 3 |
| MicB | 5321 | Physiology of Bacteria | 3 |
| MicB | 5611 | Microbial Ecology | 3 |
| ChEn | 5101,2,3 | Principles of Chemical Engineering | 4 per Q. |
| ChEn | 5751 | Biological Engineering Analysis | 3 |
| ChEn | 5754,5 | Biochemical Engineering | 4,4 |

Selected Related Field Courses:

| | | | |
|---|---|---|---|
| BioC | 5002 | Biochemistry Topics | |
| BioC | 5752,2,3 | General Biochemistry | 4 per Q. |
| BioC | 8225 | Tracer Techniques | 1-3 |
| FScN | 5120 | Food Microbiology | 5 |
| FScN | 5123 | Microbiology of Food Fermentations | 2 |
| FScN | 5135,6 | Food Process Engineering | 4 per Q. |
| FScN | 8123 | Microbial Starter Cultures | 3 |
| Phcg | 8300 | Pharmaceutical Cell Systems | 4 |
| Biol | 5003 | Genetics | 4 |
| Biol. | 5013 | General Microbiology (with lab) | 5 |
| GCB | 5031,32 | Advanced Genetics | 4,4 |

Computer Proficiency Required: (Computer courses as examples)

| | | | |
|---|---|---|---|
| CSci | 5101,2,3 | Structure and Programing of Software Systems | 4 ea |
| CSci | 3101,1100,1101 | | 2 ea |
| CSci | 3103 | | 3 |
| CSci | 3131,3134 | | 2 ea |

## Typical Chronology for MS Plan B for a student entering with a B.S. in Chem Engineering

Before enter: Biol. 5001 4Cr. and Biol. 5013 5Cr.

### Year 1

**Fall:**

MicB 8110 3 Cr.
Biol 5003 4 Cr. (Genetics)
MicB 5216 4 Cr.

**Winter:**

MicB 5321 3 Cr.
MicB 5232 3 Cr.
MicB 5106 3 Cr.
BioC 5002 3 Cr.

**Spring:**

MicB 5351 3 Cr.
MicB 8112 3 Cr.
Biol 5125 4 Cr. (Recom DNA Lab)

**Summer:**

MicB 8-2___ Preceptorship 4 Cr.
& Plan B Project

### Year 2

**Fall***

FScN 5120 5 Cr.
MicB 8910 1 Cr.
MicB 5355 3 Cr.
(Plan B Project)

**Winter:**

MicB 8121 2 Cr. (Hybridoma) Lab
ChEn 5751 3 Cr.
MicB 8910 1 Cr.
MicB 8218 3 Cr.
(Complete Plan B Project)

**Spring:**

Written Exam
Oral Exam

* MicB 5990 1 Cr.
Teaching Practicum
One Quarter in 2nd year.

Total Courses: 56 Cr.

| Related Field: | | |
|---|---|---|
| | BioC | 3 Cr. |
| | Biol | 4 Cr. |
| | FScN | 5 Cr. |
| | | 12 Cr. |

## Typical Chronology for MS Plan B for a student entering with a B.S. in Biology

Before enter: Physical Chem. 5520-21 6 Cr. or equivalent.

### Year 1

**Fall:**

ChEn 5101 4 Cr.
Math 3211 5 Cr.(No graduate credit)
MicB 5216 4 Cr.
MicB 8110 3 Cr.

**Winter:**

ChEn 5102 4 Cr.
MicB 8121 2 Cr. (Hyb. & M.A. Lab)
MicB 8218 3 Cr.
MicB 5106 3 Cr.

**Spring:**

ChEn 5103 4 Cr.
MicB 5351 3 Cr.
MicB 8112 3 Cr.
Biol 5125 4 Cr. (DNA Recom Lab)

**Summer:**

MicB Preceptorship 4 Cr.
& Plan B Project

### Year 2

**Fall***

ChEn 5104 4 Cr.
MicB 5355 3 Cr.
MicB 8910 1 Cr.
(Plan B Project)

**Winter:***

FScN 5120 5 Cr
Phcg 8300 4 Cr.
MicB 8910 1 Cr.
(Complete Plan B Project)

**Spring:**

Written Exam
Oral Exam

* MicB 5990 Teaching ( 1 Cr.) Practicum one of these Quarters

Total Courses: 64 Cr.

| | | |
|---|---|---|
| Related field: | Phcg | 4 Cr. |
| | FScN | 5 Cr. |
| Other: | Math: | 5 Cr. |
| | | 14 Cr. |

## Preceptorships in Microbial Engineering

Students will be required to carry out two 4-6 week preceptorships or one 10-12 week preceptorship usually during the summer sessions between the two resident years. Students will register for MicB 8-2___-__ Preceptorship: Microbial Engineering (Cr. Arr. 4 Cr. Maximum) during both summer sessions. There are three options available:

1. Local participating companies: Research and Development Laboratory.
2. Local participating Companies: Pilot and/or Production Facility.
3. Participating Graduate Faculty: Research laboratory.

In addition, all students must complete an intensive two week designed Fermentation Laboratory in a University biofermentation facility using modern computer controlled experimental fermenters. Students may be excused from this course if extensive fermentation experience was gained during one of their preceptorships.

## Plan B Project.

Microbial engineers are often faced with the task of preparing in depth reports evaluating and analyzing the application of basic microbiological research to technological development and eventual production of products. Therefore, the Plan B Project is central to the student's program and development. The student will choose and carry out a project subject to review and approval of the student's advisor and the Committee on Graduate Studies for Microbial Engineering. The project should be planned so as to be finally completed and approved during Winter Quarter of the Second year.

Normally the project will be developed in conjunction with research and development work done during one of the preceptorships. Thus most of the data collection and literature search should usually be completed during the summer period. The first draft of the written project will be prepared and submitted before the end of fall quarter of the second year. After approval of the completed Plan B Project during winter quarter of the second year, copies will be submitted to the final oral examining committee appointed by the Graduate School.

## Seminar Participation

Students are required to register for two (2) seminar courses in biotechnology during the second year of residency. Students must give a presentation in each of the courses. One of the presentations must be on the student's Plan B paper. In addition, all students in the program are encouraged to attend the staff seminars conducted by the Departments of Chemical Engineering and Microbiology, special guest lectures, and various colloquia conducted each quarter that relate to the areas of applied microbiology and immunology.

## Computer Profeciency Requirement

Students are required to show evidence of competence in using computers and a practical working knowledge of at least one computer language such as Pascal or Fortran or Basic.

Experience and competence may be obtained by passing two or three quarters of basic computer use and programming courses; or submitting evidence that equivalent courses of study have been completed elsewhere.

The list of acceptable courses changes rapidly. A list is available: (see page 5).

The Committee on Graduate Studies for Microbial Engineering will certify the completion of this requirement.

## Laboratory Teaching

All students, regardless of source of financial support are required to assist and instruct for one quarter in one of the laboratory courses offered in the Microbial Engineering required program. The experience gained in teaching and preparation for the laboratory is considered a clearly essential aspect of advanced study.

## Final Written Examination

A final written examination is to be successfully completed by all Microbial Engineering graduate students. This examination is designed to test the competence of the student in fundamental aspects of microbiology, immunology, molecular biology, and engineering sciences related to industrial & applied microbiology. Specific areas to be covered on the examination will be determined by the Graduate Faculty in Microbial Engineering. Administration of the exam is the responsibility of the Microbial Engineering Graduate Committee. Questions used in the exam are submitted by the Graduate Faculty in Microbial Engineering. Grading of the examination is the responsibility of the staff members whose questions were selected for the examination. The exam is taken over a six-hour period. Results of the exam are reported to the Committee, who review the graded examination and inform both student and advisor of the results. The Committee may also make recommendations, based on the test results. The grades are "pass", "pass-conditionally" and "fail". If the student fails in only one section of the exam ("passed-conditionally"), he/she is given a final opportunity to be reexamined in that section, within two weeks of the original examination. If the student fails the examination, the Committee may permit the student a final opportunity to repeat the examination. The second exam must be scheduled within one month of the original examination. The completed examination is filed in the student's personal file, and results are recorded on the Student Progress Form.

## Final Oral Examination

The final oral examination is scheduled during the final quarter of residence, which is usually spring quarter of the second year. The examination is administered by a three-member examining committee in accordance with the procedures given in the Graduate School Bulletin. The examining committee includes two members from the major field and one member from the student's related field. The student's advisor serves as the chairperson of the examining committee. The student's personal file is brought to the examination by the advisor. This allows the other members of the examining committee to familiarize themselves with the student's background. All members will have copies of the Plan B project to examine during the examination. The date and time for the examination must be arranged between the student and the members of his/her examining committee. The student must obtain the final oral examination form from the Graduate School, in order for the results to be recorded in the Graduate School.

## Personal File

A personal file is prepared for each new graduate student at the time of matriculation. The Graduate Progress Form is to be retained in the Microbiology Department office. Each student is to keep the form thoroughly up-to-date. This includes recording grades each quarter, filing a copy of the Master's Degree Program, and noting any changes in the program. Faculty are urged to write frequent informal reports and letters of recommendation concerning student teaching evaluations. These reports will be of great benefit to the student when the time comes to prepare letters of recommendation to prospective employers.

## Academic Performance

Students are expected to maintain a satisfactory progress toward the completion of their degree requirements. This includes:

(a) Performance in courses according to the standards of the Graduate School.
(b) Acceptance of the Plan B Project by the student's advisor and members of student's oral examination committee.
(c) The prompt elimination of "Incomplete" grades.
(d) Passing the final written and oral examinations.

During the first week of each quarter, the Committee on Graduate Studies meets to review the academic progress of: (1) any student on "conditional status"; (2) any student who received an unsatisfactory grade the preceding quarter; (3) any student, at the request of his/her advisor.

This procedure should be followed: Within one week following the close of each examination period, every student must record his/her unofficial grades in the Student Progress File and report the grades to his/her advisor. (Advisors should notify the committee of any unsatisfactory grades.)

## Financial Assistance

Initially students will be self-supporting in this Masters degree program. Biotechnology companies and Professors in the Graduate Faculty that direct a student for a preceptorship will be asked to support these students during the summer.

We plan to apply to local biotechnology companies, private foundations, and the federal government for financial assistance for graduate students.

C. Educational and Social Needs for the Master of Science degree in Microbial Engineering.

1. Data establishing student interest in the program.

Instructors have surveyed senior students in Microbiology classes over the past two years:

| Instructor | Class | Quarter | Microbiol. Senior Students: Total enrollment | Microbiol. Senior Students: Interested students |
|---|---|---|---|---|
| Rogers | MicB 5900 | W 1982 | 30 | 10 |
| Rogers | MicB 5900 | S 1982 | 30 | 6 |
| Rogers | MicB 5900 | S 1983 | 18 | 6 |
| Hanson | MicB 5351 | S 1983 | 35 | 15 |
| Chapman | MicB 5013 | S 1983 | 70 | 7 |

In addition, members of the graduate faculty in Microbiology have received many requests and queries concerning programs in industrial and applied microbiology over the past two years. Our impression is that there is a great deal of interest in this new program both among students in biological sciences and in chemical engineering. In addition, some workers in local Minnesota industries have called us about new opportunities for courses of study in applied microbiology.

2. Employment prospects.

a. Over the past five years, about 125 new companies and divisions of traditional industries have emerged that deal with the application of molecular and microbial technology. As pointed out by David Pramer in the enclosed article (from Biotechnology, April 1983) there is an estimated need for 35,000 biotechnologists in the U.S. by the end of this century. (See appendix C)

It is clear from this sort of forecast as well as from current advertisements for positions open for trained microbiologists knowledgeable in engineering and industrial problems that there is a future for the students completing this proposed program. (See the example ads). (See appendix C)

b. Enclosed are letters from some leading companies that employ microbiologists. (See Appendix A.) They were asked to evaluate our program during the early phase of its development. It is clear that they favor the start-up of this sort of program (called Industrial and Applied Microbiology in early versions). Some letters indicate employment opportunities for graduates of the proposed program.

As a result of these letter-responses from industry, we made important alterations in the final program submitted herein.

3. Discussion of benefits of the program:

The proposed program in Microbial Engineering is an important need for development of well trained microbiologists able to help develop and man newly emerging high technology industries utilizing biotechnology for production in Minnesota and the surrounding states.

D. Comparison with Similar Programs.

1. University Programs.

Although there are a number of graduate programs at the University of Minnesota offering the Ph.D. and M.S. degrees in, for example, biochemistry, microbiology, genetics, laboratory medicine, and medical microbiology, there is presently no program like this one.

There is an important graduate degree program in Food Science offered by the Graduate School where students may obtain the M.S. (Plan A or B) and the Ph.D. Here students emphasize the chemistry, engineering, microbiology, nutrition or technology of food products. There is some overlap with the proposed program in that some students emphasize the application of microbiology to the food industry. However, the proposed program in Microbial Engineering is designed to prepare the graduate to apply many aspects of basic microbiology including immunology to a variety of industrial and developmental research settings as well as the food industry.

Biomedical Engineering is an interdisciplinary Ph.D. program offered by the Graduate School. It is designed to provide in depth training involving interactions between engineering disciplines and the medical sciences. There is a slight degree of overlap with the proposed program in so far as a student might produce a Ph.D. thesis in the area of microbial population dynamics or chemotaxis. However, the proposed program in Microbial Engineering is directly involved with the interface between basic concepts of microbiology and their application to modern biotechnology problems at the Master of Science level.

With the development of the Biotechnology Center and the Institute for Advanced Studies in Biological Process Technology, our graduate faculty feels that this proposed degree in Microbial Engineering will fit well. We visualize this training program as cooperating closely with the research and graduate training purpose of the new center. Some of the proposed graduate faculty that are listed below are also part of the planning group for the new Institute for Advanced Studies. Thus, both the Institute and graduate training in this important area will benefit mutually when this proposed program is begun. Letters from colleges, institutes and department faculty closely involved with this proposed M.S. degree program are found in Appendix B.

2. Other U.S. Institutions Offering Similar Programs:

a. Rochester Institute of Technology
Biology Dept.
Rochester, N.Y.
B.S. Degree in Biotechnology
30 students
September 1983

b. Worchester Polytechnic Institute
Biology Dept.
Worchester, Mass.
B.S. Degree in Biotechnology

c. Cedar Crest College
Allentown, Penn.
B.S. Genetic Engineering
10 students
September 1983

d. University of Maryland
Baltimore County, MD.
Biol. & Chem. Departments
2 year plan
M.S. Applied Molecular Biology
1st degree 1984.
Genex Corp. and Bethesda Research Labs joined in partnership.
Assist in seminars, scholarships.

e. Mass. Institute Technology
Cambridge, Mass.
Dept. Nutrition & Food Science
2 degrees Biological Engineering
Started 1981
MS, Ph.D., ScD. Food Sciences.

Botstein & L. Guarante teach Biotech course stressing DNA recon. tech.

f. University of Illinois at Chicago.
High Tech Research park in Chicago. Univ. of Ill. Gene Research Center also Centaur Genetics, Inc. and Applied Molecular Genetics, Inc. will move there.

g. University of North Carolina
Chapel Hill.
Promote research and education in genetic engineering.
Program in molecular biology & biotechnology.
School of Medicine. M H department.
No degree yet. MS and BS in planning stage.

h. Penn State University
Program in biotechnology. Cooperative programs in Recom DNA Tech. The view is to develop Ph.D., Post doc, M.S. degrees to meet research & production needs of biotech industry. Developing courses on Fermentation Tech., Bacterial Physiol., Recon DNA Tech, 5 industries will support $140,000/year 5 years. Start July 1983.

i. University of Michigan. Center for Molecular Genetics.
Organized to provide a focus for research in biotechnology. It is an interdisciplinary group lead by Dale Oxenader with 14 University departments in 7 schools or institutes of the University involved. A new training program at the B.S. and M.S. level is being considered that will include genetics, microbiology and chemical engineering.

From the above list, it is clear that there are a number of new programs for research and training emerging in both small and large universities. Large training programs in applied molecular biology, biotechnology and fermentation technology are developing in response to apparent needs in the new biotechnology industry.

The new training program in process at the University of Michigan will carry a marriage of basic genetics, microbiology and chemical engineering. This concept is similar to the one proposed here.

E. Quality Control.

1. The Graduate Faculty in Microbial Engineering.

The quality control and ultimate development of the program will be the responsibility of the graduate faculty in Microbial Engineering. Because of the interdisciplinary nature of the proposed training the faculty (see Appendix B) are found in more than nine departments of four institutes and colleges. The faculty are in general agreement with this outline of the proposed program in Microbial Engineering and have agreed to participate in it.

Procedures by which the program is governed.

The graduate faculty will elect a Committee on Graduate Studies consisting of a Director of Graduate Studies and 5 or 6 members. They will administer the program for the faculty and graduate students.

The changes in and evaluation of the program will be generated in the Committee of Graduate Studies representing the Graduate Faculty in Microbial Engineering.

The Policy and Review Council for the Health Sciences or other Policy and Review Council will be assigned by the Dean of the Graduate School to approve any changes and evaluate the progress of the proposed program.

The Dean of the Graduate School will schedule systematic reviews and evaluations of this program as with other graduate programs of the University of Minnesota.

F. Implementation

1. Time schedule for start-up of the Microbial Engineering program.
Fall 1984: Start first group of about four graduate students.

June 1985: First class begins summer preceptorships either in local industries or at specific locations on Twin Cities campuses such as the New Fermentation Center or at the Freshwater Biology Institute.

Fall 1985: Start second group of about six graduate students. First class of students begin the second year of the program.

June 1986: First class of students completes MS degree in Microbial Engineering. Second class begins summer preceptorship.

Fall 1986 and subsequent years: The class size will be limited to about six new students per year. Additional student positions will depend upon additional funds for new faculty, and funds and positions in local industry for support of students and summer preceptorships.

2. University Resources.

a. Courses and Faculty teaching:

All of the courses listed in the program have been approved by the college units and/or the Graduate School with the exception of the courses discussed below.

Over the past two years the Graduate faculties of Microbiology, Biochemistry and Genetics have developed the important courses for this and related graduate programs. The new courses MicB 5351, 5106, 5355 and Biol 5125, (see page 5 of this proposal) are examples that have now been in operation one or two years and are highly successful. Faculty are already committed to these and all other courses listed.

The following courses (see page 5) will need new or reallocated faculty effort in order to implement this program: Two are new courses which are not yet formally proposed.

MicB 82XX Preceptorship: Microbial Engineering Cr. Arr. (4 Cr. max)

(Biol.)___ Biofermentation Laboratory, ___Cr.

One is a course which is approved but must be altered and faculty allocated.

MicB 8218 Advanced Immunology Laboratory, 2 Cr.

The MicB 82XX Preceptorship: Microbial Engineering is described in detail on page 6. It forms the important practical experience for students and forms the basis for the Plan B project.

We have obtained committments from two local companies and from the Director of the Freshwater Biology Institute for direction and space provision for students (See Letters in Appendix B).

The proposal for this course will be developed during the Fall of 1983.

(Biol)____ Biofermentation Laboratory, __ Cr. has not been developed. The New Fermentation Biology and Technology Program will be set up in its new facility in the Gortner Laboratories within the next 18 months. This will include both modern fermentation equipment and new faculty for the program. New course offerings in fermentation will be vital to this program.

Estimates are that this equipment and faculty will be operational by the summer of 1985. (See letter appendix B).

MicB 8218 Advanced Immunology Laboratory, 2 Cr. is to be changed to include new techniques in hybridoma and monoclonal antibody research. Presently, there is no faculty available to teach this course. During 1984, the Dept. of Microbiology will be recruiting new junior faculty position with research interests in immunology; Funds have been reserved for making these new appointments.

b. Faculty advising and administration.

A Director of Graduate Studies for Microbial Engineering will have to be elected along with committee members from the Graduate Faculty. This will require time and effort. This will be reallocation of time.

Occasionally students may decide to develop a preceptorship in an individual faculty laboratory. This will require only a summer allocation of space and faculty advising time. All students will be assigned faculty advisors to advise them in designing their programs, and writing the Plan B projects.

c. Support staff.

Office staff for correspondence and office administration of the program will require time and effort from the Dept. of Microbiology Office Staff. Initially, a reallocation of work effort within the present staff may be possible. However, as the program continues additional secretarial support will be necessary. The office space to run the program ( Rms. 1460 Mayo) is adequate.

3. Community Resources

As noted in the discussion and implementation of the preceptorship program, leadership and participation by midwest biotechnology companies is essential to this program.

It is clear that two local companies have already committed a summer research student position for this program. We envision further participation in the future from other companies as the program progresses.

We are also developing a plan to involve midwest companies in support of these Master's students during their studies. During 1984 our planning committee will be developing a fellowship program supported by specific industries involved in microbial engineering.

4. Cost Analysis of the Microbial Engineering Program.

Cost analysis is computed as follows:

First Year

| | | |
|---|---|---|
| a. | 10 Graduate Faculty @ 5% time ($45,000/annum) = .5 FTE plus 24% fringe benefits (Reassigned) | $27,900 |
| | Secretary 50% @ 11,904 plus 22% fringe benefits (Reassigned) | $7,259 |
| b. | Supplies: Laboratory supplies for Recombinant DNA course | 2,000 |
| | | $37,159 |

Second Year (Full Operation)

| | | |
|---|---|---|
| a. | 50% Ass't Prof. @30,000 + 24% fringe benefits | 22,200 |
| b. | 50% Secretary @22,904 plus 22% fringe benefits | 7,259 |
| c. | Supplies (same) | 2,000 |
| | | $31,459 |
| | | $68,618 |

All funds would be reassigned from present departmental budget sources. Percentages were computed on the basis of a #3,000,000 (first year) and $3,500,000 (second year) total Microbiology Department budget (state plus federal plus private grants).

We have not included private funds at this time because they are indefinite. We have a commitment from Molecular Genetics, Inc. for the support of one graduate assistant during his/her summer preceptorship (Estimated $1400). These funds will accrue to the student rather than the program.

It is our hope that fellowship support can be obtained for students, either from internal or external sources, since second year students will be required to teach in the laboratory courses. We are investigating several potential sources.

## Appendix A

### Letters from Private Industry Concerning the Proposed Program.

Many of these letters were obtained during an early phase of developing this program, when it was developed as a 5 year B.S. program rather than a M.S. degree. Some of the responses induced changes during the final phase of development of this program.

Genex Laboratories included a copy of the University of Maryland program in "Applied Molecular Biology" demonstrating a biotechnology company - University cooperative venture in education.

MERCK SHARP & DOHME

RESEARCH LABORATORIES

DIVISION OF MERCK & CO., INC. • P. O. BOX 2000, RAHWAY, NEW JERSEY 07065

JEROME BIRNBAUM, PH.D.
VICE PRESIDENT
MICROBIOLOGY RESEARCH & DEVELOPMENT
(201) 574-6582

September 29, 1981

Dr. Palmer Rogers
Director of Committee on
Undergraduate Studies
University of Minnesota
Department of Microbiology
1060 Mayo Memorial Bldg., Box 196
420 Delaware Street S.E.
Minneapolis, MN 55455

Dear Dr. Rogers:

Thank you for your letter of August 11.

I think your program in a B.S. degree in industrial and applied microbiology is a fine idea and a very timely one. I think the curriculum that you have chosen is a good one. I really can't provide any further advice, except to add that in the chemical engineering courses, bioengineering (using stirred-tank fermentations) should be included. Also, heavy emphasis on techniques, instrumentation (especially high performance liquid chromatography) should be included throughout the laboratory phases of several of the courses.

It is important to provide your studenst with broad exposure to industrial type microorganisms; yeast, fungi, streptomycetes and unusual bacteria...not simply to E. coli. Most of the organisms that are of interest to us are quite different to usual "academic" microorganisms. Knowledge of the biochemistry, genetics and physiology of these species would be very helpful to your graduates.

I'd be happy to consider graduates from your program for technical staff positions in Merck.

Sincerely,

Jerome Birnbaum/dd

Jerome Birnbaum

/dd

cc: Dr. Martin Dworkin
Professor of Microbiology
University of Minnesota

THE DOW CHEMICAL COMPANY

September 22, 1981

M. E. PRUITT RESEARCH CENTER
MIDLAND, MICHIGAN 48640

Dr. Martin Dworkin
Professor of Microbiology
Medical School
University of Minnesota
1060 Mayo Memorial Building, Box 196
420 Delaware Street, S.E.
Minneapolis, MN 55455

Dear Dr. Dworkin:

We appreciate your bringing to our attention your proposed program for students in applied and industrial microbiology. Please understand that I can comment only with regard to my feelings concerning the needs for graduates of such a program specific to Dow's interests and perhaps more generally with regard to chemical oriented companies.

A review of the curriculum would lead me to believe that a very limited number of people with the training you propose would be useful to us as was discussed with you about a year ago. It is my feeling that a masters level would permit a stronger chemistry background which I feel would be a distinct advantage. Another suggestion would be the inclusion of fermentation processes and separation of fermentation products. While these may be touched on in some of the courses listed, I doubt seriously that time would permit enough intensity in the above subjects to be commercially useful.

In summary, my view of the proposed curriculum is that the mathematics are adequate, the chemistry and biochemistry perhaps too weak, the chemical engineering is probably adequate, but would be enhanced if fermentation processes were included and the microbiology of necessity leaves something to be desired.

I do think you are looking in the right direction and feel that your approach is likely to evolve into what I believe will be a reasonably high demand graduate in the industrial sector if the areas critiqued can be improved.

Sincerely,

R. E. Hefner
Director
Central Research

cc: W. H. Riley, Bioproducts Lab, Central Research

PHILLIPS 66

PHILLIPS PETROLEUM COMPANY
BARTLESVILLE, OKLAHOMA 74004 918 661-6600

RESEARCH AND DEVELOPMENT

September 23, 1981

Dr. Palmer Rogers
Department of Microbiology
University of Minnesota
1060 Mayo Memorial Building, Box 196
420 Delaware Street S.E.
Minneapolis, MN 55455

Dear Drs. Palmer Rogers and Martin Dworkin:

This letter is in response to your letter of August 11, 1981 asking for advice on a proposed curriculum for a new B.S. program in Industrial and Applied Microbiology. I discussed this proposed program with several of our microbiologists and we have the following general comments.

1. Your curriculum looks good to us.
2. Engineer courses with training in mass and heat transfer and in separations would be a useful asset to an industrial microbiologist.
3. Hands on experience in setting up and running lab or pilot scale fermentations would be valuable. We noted that your Applied/ Industrial Microbiology course doesn't include a lab.
4. I would suggest that Dick Hanson at the Fresh Water Institute could assist in teaching the industrial microbiology course for he has broad experience in this area.

You asked for specific comments on whether or not an individual so trained would be an attractive candidate for employment in our organization. In the past all microbiologist we have hired have been at the Ph.D. level. However, as our research program matures and moves into the pilot plant and process development stages we may have a need for individuals with the training you propose. I would think that other companies that have a long standing commitment to fermentation processes would have an interest in individuals so trained.

Gene H. Wegner

Gene H. Wegner, Ph.D.

GHW:sgh

Lilly

Lilly Research Laboratories
A Division of Eli Lilly and Company

307 East McCarty Street
Indianapolis, Indiana 46285
(317) 261-2000

October 2, 1981

Martin Dworkin, Ph.D.
Department of Microbiology
Medical School
1060 Mayo Memorial Building
Box 196
420 Delaware Street S. E.
Minneapolis, Minnesota 55455

Dear Professor Dworkin:

Thank you for the opportunity to comment on the curriculum for the Bachelor of Science Degree in Industrial and Applied Microbiology. From my prospective, I believe the curriculum is excellent. My only suggestion would be to try to introduce an additional quarter on applied and industrial microbiology. The field is extremely diverse and I believe that at least two quarters should be devoted to specific applied and industrial microbiology topics. I think the students should also receive instruction in fermentation equipment and its utilization. They should also be exposed to the many diverse areas of applied microbiology ranging from biodeterioration to energy production, renewable resource utilization, antibiotic production, etc.

I have taken the liberty of forwarding your letter to the Chairman of the Education Committee for the Society for Industrial Microbiology. As President of the Society, I am asking that that Committee review your proposed curriculum and send their recommendations on to you.

Thank you again for your inquiry.

Yours truly,

Bernard J. Abbott

Bernard J. Abbott

BJA:ssk

cc: Dr. Robert W. Schwartz

SK&F
a SmithKline company

SMITH KLINE &FRENCH LABORATORIES
1500 Spring Garden St., P.O. Box 7929, Philadelphia, PA 19101 • 215-854-4000
cable SMITHKLINE PHILADELPHIAPA
telex 83-4487

September 30, 1981

Martin Dworkin, Ph.D.
University of Minnesota
Dept. of Microbiology
Medical School
1060 Mayo Memorial Bldg., Box 196
420 Delaware Street S.E.
Minneapolis, Minnesota 55455

Dear Dr. Dworkin:

The recent explosion in biotechnology has created an unusual demand for highly trained technical people to work in established and emerging companies. In the present labor pool, there is an insufficient number of highly trained technical support personnel. During the next few years, the nature of his demand will change and new talent will be required, e.g., microbiologists for quality control, process development, marketing, etc.

One of the major problems in developing a curriculum for training technical support personnel is the diversity of jobs that exist in industry. In general, it is desirable for an individual at the B.S. level to have good fundamental training in math, chemistry, and microbiology. Training in engineering and genetics is a definite advantage. Students completing the proposed curriculum at the University of Minnesota would be well prepared to take a job in industry. The ability of graduates to compete in the job market would be further enhanced by incorporation of some type of work study program. Practical laboratory experience is a key component in the success of the new employee. Many companies will hire a candidate with an M.S. degree or with some work experience rather than depending on on-the-job training. Incorporation of two three-month work periods and another course on practical laboratory methodology would make the University of Minnesota graduate even more competitive.

Good luck with your program.

Sincerely,

Claude Nash

Claude H. Nash III, Ph.D.
Director, Anti-Infective Chemotherapy
and Molecular Genetics

Monsanto

Monsanto Company
800 N. Lindbergh Boulevard
St. Louis, Missouri 63166
Phone: (314) 694-1000

October 14, 1981

Dr. Palmer Rogers
Director of Committee on
Undergraduate Studies
University of Minnesota
1060 Mayo Memorial Building, Box 196
420 Delaware Street S.E.
Minneapolis, MN 55455

Dear Dr. Rogers:

Unfortunately, your letter of 8/11/81 was not delivered until 9/21/81. In response to your request I asked two of our Scientists/Managers to comment on the program. Let me summarize their feelings:

A. I like it but would suggest biochemistry be moved up to between 2 quarters and 1 year.

B. Seems to be at the expense of basic science. Prefer that general, organic and analytical chemistry all be one year. Calculus and physics - 2 years. More lab work

We realize that curriculum design demands trade offs. The above are verbatim responses. Best of luck in your current projects.

Sincerely,

P. R. Schenkenberg

P. R. Schenkenberg
Manager, Personnel
Corporate Research Laboratories
and Biotechnology

R. Squibb & Sons, Inc.

SQUIBB

e Squibb Institute for Medical Research
O. Box 4000
nceton, NJ 08540
9-921-5083

Cable: ERSQUIBB NY

CHARD B. SYKES, Ph. D.
ociate director
ector, microbiology

October 21, 1981

Dr. Martin Dworkin
Professor of Microbiology
University of Minnesota
Medical School
1060 Mayo Memorial Building
Box 196
420 Delaware Street, S.E.
Minneapolis, Minnesota 55455

Dear Professor Dworkin:

In reply to your letter of August 11 concerning a curriculum for a Bachelor of Science Program in Industrial and Applied Microbiology.

In the Physical Sciences and Mathematics Section: I would question the necessity of 1 qtr. of Multivariable Calculus.

In the Biology Section: A. and B. may be better handled as a 1 qtr. of Zoology and 1 qtr. of Botany. Biochemistry should have a lab.

In the Microbiology Section: The lab on recombinant techniques is better held at the graduate level. E. may include isolation of organisms from clinical material.

Medical Microbiology should be required.

Hopefully these suggestions will help you in your planning.

Sincerely yours,

RBSykes

Richard B. Sykes

Genex

Reply to:

Genex Laboratories
12300 Washington Ave.
Rockville, Md. 20852
(301) 468-6622

October 7, 1981

Palmer Rogers, Ph.D.
Martin Dworkin, Ph.D.
University of Minnesota
Department of Microbiology
Medical School
1060 Mayo Memorial Building, Box 196
420 Delaware Street, S.E.
Minneapolis, Minnesota 55455

Gentlemen:

I am writing in response to your letter to Dr. Leslie Glick dated August 11, 1981 in which you requested advice on relevance and value of a new Bachelor of Science program in Industrial and Applied Microbiology.

Recognizing the needs of rapidly expanding biotechnology companies, Genex became affiliated with the University of Maryland Baltimore County in a program entitled, "Applied Molecular Biology with emphasis in Recombinant DNA Technology". I have enclosed relevant background information.

Best of luck in your program.

Sincerely,

Sheila B. Fullenbaum

Sheila B. Fullenbaum
Personnel Manager

SBF/tm

Enclosures

# APPLIED MOLECULAR BIOLOGY

## with emphasis in

## Recombinant DNA Technology

## University of Maryland Baltimore County (UMBC)

The new biotechnology will surely be one of the major growth industries of the late 20th century. The needs of rapidly expanding biotechnology companies, and of basic research institutions, have already resulted in a heavy demand for professionals trained in recombinant DNA techniques and other aspects of modern molecular biology. Much of this demand is for baccalaureate-level graduates able to operate with some degree of autonomy in laboratory situations. In order to meet the need for this kind of science professional, a training curriculum in Applied Molecular Biology has been established at the University of Maryland Baltimore County. This baccalaureate-level curriculum is offered jointly by the departments of Biological Sciences and Chemistry, and complements existing M.S. and Ph.D. programs currently administered by the respective departments. The course of study has been developed in close collaboration with two biotechnology companies in the Baltimore-Washington-Frederick area, Bethesda Research Laboratories and Genex Corporation. It takes advantage of vigorous ongoing research programs in molecular biology and related areas at UMBC.

LOCATION: UMBC is a comprehensive research-oriented university center offering B.A., M.A., M.S., and Ph.D. degrees. Situated in suburban Baltimore, UMBC is convenient to the Washington, DC and Frederick, MD areas. The Baltimore-Washington-Frederick triangle is the location of several biotechnology companies and many major biomedical research centers, including the National Institutes of Health, the Johns Hopkins University and the Frederick Cancer Research Center.

COURSE OF STUDIES: Thirty credit hours at the advanced baccalaureate level taken at UMBC are required: comprehensive biochemistry (2 semesters); procaryotic and eucaryotic molecular biology (2 semesters); analytical chemistry (1 semester); biochemistry laboratory (1 semester); advanced molecular biology laboratory (recombinant DNA techniques) (1 semester). The intensive laboratory courses stress basic concepts as well as skills, and emphasize the development of science professionals capable of independent work. Students can complete the course requirements in one year. Alternatively, undergraduates who major in Biochemistry/Molecular Biology (or related fields) at UMBC can spread the course work over two years.

ELIGIBILITY: Upper division students enrolled at UMBC and baccalaureate graduates of other institutions may be considered for enrollment in the Applied Molecular Biology program. Interested students must have completed the following courses, or their equivalents, prior to enrollment in the program: general chemistry (2 semesters); organic chemistry lecture and laboratory (2 semesters); genetics (1 semester); cell biology (1 semester); biology laboratory (2 semesters); physics (2 semesters); and calculus (1 semester). (Note that completing the requirements of the course of study in Applied Molecular Biology may enable students to earn an additional baccalaureate degree.)

ACCEPTANCE INTO THE PROGRAM: Enrollment in the program is limited. Interested students not currently enrolled at UMBC must submit the following to the Office of Admissions:

- An undergraduate application
- A letter of interest which describes the applicant's academic experience and the relevance of the course of study to the individual's carer goals
- Two letters of recommendation
- Transcripts of all previous college level education.

Interested students who are currently enrolled at UMBC must submit all the above materials, except the application and transcripts. For additional information please contact the Office of Admissions, University of Maryland Baltimore County, Catonsville, MD 21228 (Telephone: 301-455-2291).

FINANCIAL AID: Scholarships in Applied Molecular Biology at UMBC have been established by Genex Corporation and Bethesda Research Laboratories. Students will be considered for these scholarships on a competitive basis. Applicants should contact the Financial Aid Office at UMBC if they wish to explore other sources of aid.

DESCRIPTION OF COURSES: The course of study in Applied Molecular Biology may be completed in a single academic year by students who have met the prerequisites.

| Fall | Spring |
|---|---|
| CHEM 0437 | CHEM 0438 |
| BIOL 0420 | BIOL 0411 or |
| CHEM 0300 | BIOL/CHEM 0433 |
| CHEM 1430 | BIOL/CHEM 1435 |

BIOL 0411 MICROBIAL GENETICS Credits: 4

This course illustrates the basic methods and concepts of microbial genetics and molecular biology and their application to the analysis of biological phenomena. Topics include regulation of gene expression in prokaryotes and transposable elements.
Prerequisite: BIOL 0310 (Molecular and General Genetics)

BIOL 0420 ADVANCED TOPICS IN CELL BIOLOGY, Section 201 Credits: 4

This course will focus on the molecular biology of eucaryotic cells and will include such topics as the sequence organization of DNA and genes, chromosome structure, messenger RNA synthesis and processing messenger RNA translation, and the regulation of the expression of genetic information.
Prerequisite: BIOL 0320 (Cell Biology) or consent of the instructor.

BIOL/CHEM 0433 GENETIC BIOCHEMISTRY Credits: 3

A detailed treatment of genetic phenomena and the biochemical events underlying them. The approaches and techniques of nucleic acid biochemistry, genetic analysis, and molecular biology are used to study one or two well characterized procaryotic biological systems. (Spring)
Prerequisites: CHEM 0437 and BIOL 0310 (Molecular and General Genetics).

CHEM 1430 BIOCHEMISTRY LABORATORY CREDITS: 4

Modern methods of biochemical research. Laboratory experiments are designed to provide experience in working with biologically active materials and familiarity with standard biochemical techniques. These include spectrophotometry; chromatography; isotope tracer techniques; ultracentrifugation; enzyme kinetics; isolation, purification and characterization of proteins, nucleic acids and subcellular organelles. Two laboratory sessions per week. (Fall)
Corequisites: CHEM 0430 and consent of the instructor.

BIOL/CHEM 1435 ADVANCED MOLECULAR BIOLOGY LABORATORY Credits: 7

A course designed to demonstrate the application of recombinant DNA technology and other approaches and methodologies of molecular biology to the study of gene regulation, chromosome organization and eucaryotic development. Emphasis is on acquiring facility in the design of experiments, analysis of data, and troubleshooting, as well as in developing a broad range of technical skills, and the ability to use modern laboratory equipment. One or two model experimental systems will be used to provide experience in the following procedures: preparation of bacteriophage and plasmid DNA, gel electrophoresis, cloning, restriction enzyme mapping, Southern blot analysis, DNA sequencing, isolation of mRNA, in vitro translation, preparation of cDNA, heteroduplex mapping and manipulation of $^{32}$P-labelled nucleic acids. Three laboratory sessions and one lecture per week. (Spring)
Prerequisites: CHEM 0437, CHEM 1430,, and one of the following: BIOL 0411, BIOL 0420, BIOL/CHEM 0433. Consent of the instructor required. Corequisite: CHEM 0438.
Note: Enrollment may be limited to students in the Applied Molecular Biology Program.

CHEM 0300 ANALYTICAL CHEMISTRY Credits: 4

A laboratory course in qualitative and quantitative analysis; volumetric, gravimetric and spectrophotometric techniques are included. (Fall)
Prerequisite: CHEM 1102 (Introductory Chemistry Lab)

CHEM 0437 COMPREHENSIVE BIOCHEMISTRY I Credits: 4

Part of a two-semester sequence providing a thorough introduction to modern biochemical principles. Major topics include structures and properties of biomolecules, metabolic pathways for generation and storage of cellular energy, biosynthetic pathways, enzyme properties, replication and expression of genetic information, regulatory mechanisms. (Students will be introduced to the research literature by means of an individual project.) (Fall)
Prerequisites: BIOL 0100 and CHEM 0252 or equivalent.

CHEM 0438 COMPREHENSIVE BIOCHEMISTRY II Credits: 4

Continuation of CHEM 0437. (Spring)
Prerequisites: CHEM 0437 or equivalent.

Valmer - Here's a good one

E. I. DU PONT DE NEMOURS & COMPANY
INCORPORATED
WILMINGTON, DELAWARE 19898

CENTRAL RESEARCH & DEVELOPMENT DEPARTMENT
EXPERIMENTAL STATION

October 28, 1981

Professor Martin Dworkin
Department of Microbiology
Medical School
1060 Mayo Memorial Building, Box 196
420 Delaware Street S.E.
Mineapolis, Minnesota 55455

Dear Professor Dworkin:

Your letter of August 11 to Dr. Hardy requesting comment on the proposed BS program in Industrial and Applied Microbiology at the University of Minnesota has been referred to me. As you may know, I have management responsibility for Molecular Genetics, Virology and Fermentation Microbiology under Dr. Hardy's direction at Du Pont. I am very pleased to have an opportunity to comment positively and enthusiastically about your program.

Much is written these days about the industrial potential of applications of genetic engineering. If this potential develops in a major way, the United States is going to need a lot more people with technical skills relating to fermentation processes all the way from the laboratory to the plant. These skills embrace microbiology, biochemistry, chemistry and chemical engineering. Your proposed program is right on target to provide the needed background. As you know, such programs are very few in this country and I congratulate you in your perception of this need and in your actions to do something about it.

At the present time, we are hiring primarily at the PhD level for our fermentation related research programs. I expect that there will be some opportunities for BS level people in the future. We would be pleased to consider graduates from your proposed program as employment candidates.

I hesitate to suggest any changes in your proposed curriculum because I am sure you are much more knowledgable in this area than I am. However, since you have invited comments I will make a few that would seem relevant to background that I would be seeking in an employment candidate. I recommend more emphasis on analytical chemistry and separation processes at the expense of multivariable calculus, foreign language and some reduction in physics. Some direct experience in mutagenesis and screening for desired mutants would be useful.

Yours sincerely,

C. C. McDonald

C. C. McDonald
Research Manager

CCM:mpw
10/28/81

CALOR Agriculture Research

Calor Agriculture Research, Inc.
207 4th Street
P.O. Box 190
Luxemburg, Wisconsin 54217
Telephone (414) 845-2313

FWJ:KP

26 April 1983

Dr. Palmer Rogers
Department of Microbiology
Mayo Memorial
University of Minnesota
Minneapolis, MN 55455

Dear Palmer:

With the short time we had to discuss the MS Microbial Engineering program, I suspect some of my comments are based on incorrect assumptions.

When we have a position for an engineer or microbiologist we specifically search for those trained in that field. We feel that qualified engineers will likely be poor microbiologists with the reverse also true. Consequently we would likely review the MS engineer in the proposed program to be a BS level engineer with strong interest in genetic engineering. If the position were for genetic engineering development this person would most definitely be given preference over one with an engineering background alone. For the BS biologist, the program would give the person a good microbiology background and would likely be considered a MS level microbiologist.

I am not sure how genetic engineering and biotechnology industries would view graduates of this MS program. Many companies feel that if a good engineer and a good microbiologist are charged with developing a project, the "best" process should emerge because both are experts in their respective fields. Based on the course work outlined, I would not consider the biologist as having more than an introduction to engineering. Similarly the engineer would likely be reviewed as not being a competent microbiologist. On the positive side, the introduction and training in two important aspects of biotechnology would allow each to understand the problems inherent in both disciplines which could result in surprising new innovations and developments of highly efficient process. In short, both may be in high demand in industries related to biotechnology.

The program for engineers may be a bit too heavy in microbiology work which may inhibit good engineers from entering the program. Possibly some advanced course work in process/plant design, instrumentation, fermenter design and protein product recovery could be added while some of the microbiology dropped or scaled down.

The program for the biologist seems to be better balanced. The chemical engineering courses should give the student a firm grasp of what engineers do, how they view their work, and what types of assumptions they are willing to make to complete their assignments. I would recommend the engineering courses include principles of design, instrumentation and product recovery with emphasis on protein recovery.

The idea of a project being done in association with local participating companies is excellent. It would provide the student with an opportunity to sample commercial research and its basic philosophy. One problem may be confidentiality and how that might be protected. At least with our group, confidentiality is a prime concern and I doubt we would ever allow someone to work in our laboratories without full rights to edit and prevent disclosure of anything considered by the company as confidential. The student would also be required to sign a comprehensive confidentiality/patent rights agreement before entering the laboratories, and the University would have to agree to protect the rights of the company.

I hope these comments are helpful. As you know I am not directly involved with microbial engineering and have based these views on my experience in fermentation development and plant scale R/D. If you wish to discuss any issue in more detail please call or write.

I enjoyed my visit to Mayo and our conversations. Hope you eventually establish the Biotechnology Institute.

Best regards,

F. W. Juengst

F. W. Juengst
Executive Vice President

Genentech, Inc.

Point San Bruno Boulevard
South San Francisco, CA 94080
952-1000
910 371 7168

September 21, 1981

Dr. Palmer Rogers
Director of Committee on
Undergraduate Studies
University of Minnesota
420 Delaware Street S.E.
Minneapolis, Minnesota 55455

Dear Dr. Rogers:

Mr. Robert Swanson has asked me to respond to your letter requesting comments on your proposed program in Industrial and Applied Microbiology.

First, let me say that the concept of training undergraduates in Industrial and Applied Microbiology principles is an exciting prospect and we certainly encourage your department to pursue the idea.

The details of how one accomplishes the task are more problematic. The following are some of my thoughts on the subject and a few questions and suggestions:

1. If the new curriculum does not sacrifice training in humanities and basic sciences, and I agree it should not, then I must assume that it will increase the number of quarters a student must attend school to obtain a Bachelor degree compared to other disciplines (e.g., Biology, Chemical Engineering, etc.). If I am right, what then is the incentive for a student to enter the program? He or she might find taking a Bachelor in Chemical Engineering and Master in Microbiology, or vice versa, more attractive. I certainly would.

2. In judging the capabilities of candidates to the Research and Development group to Genentech, we carefully look at the laboratory experience of such a candidate. From your proposed curriculum, I see that you will have students participate in a large number of laboratories. I think this is good, however, I should like to add two points:

   - One wonders if regularly scheduled and preplanned laboratory exercises serve the purpose of training good technicians. It would be advantageous to introduce students to a certain amount of independent research and scientific logic.

When I was at M.I.T. we did this with a high degree of success. I suggest that you get in touch with Professor Charles Cooney, Department of Nutrition and Food Science at M.I.T. He has run the Undergraduate Research Opportunities Program in the department and can probably help you.

- I suggest that the Applied/Industrial Microbiology course be coupled with the lab in Bacterial Physiology and the one in Genetics. Students must be shown the relationship between the applied and fundamental aspects of microbiology.

I hope that these comments are useful to you.

Sincerely yours,

Reinaldo F. Gomez, Ph.D.
Director, Biocatalysis

RFG/cah

cc: R. A. Swanson

Appendix B

Letters offering summer preceptorships

Dr. Richard Hanson, Director, Freshwater Biological Institute
Franklin Pass, M.D., President, Molecular Genetics, Inc.

Letters from involved university units

Dean V. Rama Murthy, Institute of Technology
Dr. H. Ted Davis, Head, Dept. of Chemical Engineering

Dean Richard S. Caldecott, College of Biological Sciences
Dr. Victor Bloomfield, Director, Biotechnology Research Center and Head, Department of Biochemistry.

Dr. Joseph J. Warthesen, Director of Graduate Studies in Food Science, Department of Food Science and Nutrition

Proposed Graduate Faculty in Microbial Engineering.

Example Letters from Faculty

UNIVERSITY OF MINNESOTA
TWIN CITIES

Gray Freshwater Biological Institute
College of Biological Sciences
P.O. Box 100
County Roads 15 and 19
Navarre, Minnesota 55392
(612) 471-8476

June 16, 1983

Dr. Palmer Rogers
University of Minnesota
Department of Microbiology
1015 Mayo Memorial Building
420 Delaware St. S.E.
Minneapolis, MN 55455

Dear Palmer:

The Gray Freshwater Biological Institute presently has four 15 liter fermenters and we anticipate the installation of a 300 liter computer controlled fermenter and harvesting facility in the next year. We are also involved in studies of cell immobilization and biodegradation of aromatic compounds in soil and contaminated water. All could involve bioengineers and we would be happy to participate in the preceptorship program in Microbial Engineering. We normally take several summer students (nine this summer) so the Microbial Engineering students should fit into our programs in a meaningful way.

Sincerely,

Dick H.

R.S. Hanson
Director, Gray Freshwater Biological Institute

RSH/d

Molecular Genetics Inc

10320 Bren Road East
Minnetonka, Minnesota 55343
612, 935-7335

June 23, 1983

Palmer Rogers, Ph.D.
Department of Microbiology
Box 196 Mayo Memorial Bldg.
Minneapolis, MN 55455

Dear Doctor Rogers:

The management of Molecular Genetics is pleased to see the plans for a new Master of Science degree program in Microbial Engineering. We feel that there is a crying need for trained people at this level in a company such as ours.

We would be excited to participate in this program. We will be pleased to take a student on a summer preceptorship in either our pilot fermentation or manufacturing facility. Furthermore, we would be pleased to contribute financial support for the student during the summer preceptorship.

We do hope that you are successful in launching this program in a timely fashion.

Sincerely yours,

Frank Pass

Franklin Pass, M.D.
President

eh

Office of the Dean

UNIVERSITY OF MINNESOTA
TWIN CITIES

Institute of Technology
107 Lind Hall
207 Church Street S.E.
Minneapolis, Minnesota 55455
(612) 373-2955

August 2, 1983

Dr. Palmer Rogers
Department of Microbiology
1015 Mayo
East Bank Campus

Dear Palmer:

I have reviewed the proposal that you recently sent me concerning the establishment of a Master of Science degree program in Microbial Engineering. I endorse this proposal very strongly, and I believe that the program will relate quite nicely with teaching and research in at least two departments of the Institute of Technology, namely Chemical Engineering and Chemistry.

Please let me know when the program has been approved by the Graduate School.

Best regards.

Sincerely,

Rama

V. Rama Murthy
Acting Dean

VRM:jc

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Chemical Engineering and Materials Science
151 Amundson Hall
421 Washington Avenue S.E.
Minneapolis, Minnesota 55455
(612) 373-2300

July 18, 1983

Marty Dworkin
Department of Microbiology
915 Mayo
University of Minnesota
Minneapolis, MN

Dear Marty:

I have consulted with the bioengineering faculty in the department. They and I believe the microbial engineering degree program your department has designed will be a benefit to the University in general and to our own bioengineering program in particular. On behalf of the department, I would like to register strong support for the program and to assure you that we will try to be as helpful to you in this endeavor as we can.

Yours sincerely,

Ted

H. Ted Davis
Professor and Head

HTD/mmm

Office of the Dean

UNIVERSITY OF MINNESOTA
TWIN CITIES

College of Biological Sciences
123 Snyder Hall
1475 Gortner Avenue
St. Paul, Minnesota 55108

July 25, 1983

Dr. Palmer Rogers
Dept. of Microbiology
Box 196 Mayo Bldg.
Mpls. Campus

Dear Palmer:

Thank you for giving me the opportunity to review the proposal on Microbial Engineering. I think it is excellently conceived and I am planning that CBS faculty members will play a role in the program. In short, it's sound in planning and concept.

As you know, CBS is playing an active role in developing an intercollegiate program which is expected to use living cells as production lines for a variety of different products. The M.S. program you envision should fit nicely into what we are planning and I think your efforts and ours are quite complementary. If there is anything I can do to help the program get underway, kindly let me know.

Sincerely yours,

Dick

Richard S. Caldecott
Dean

RSC/mt

UNIVERSITY OF MINNESOTA
TWIN CITIES

Biotechnology Research Center
140 Gortner Laboratory
1479 Gortner Avenue
St. Paul, Minnesota 55108
(612) 373-1303

July 21, 1983

Prof. Palmer Rogers
Department of Microbiology
1060 Mayo Memorial Building, Box 196
Minneapolis Campus

Dear Palmer:

The development by the Microbiology Department of the MS Program in Microbial Engineering is an extremely important component of our efforts to build a Biological Process Technology Institute of national stature within the Biotechnology Research Center. We are attempting to develop in the Institute a core of faculty and facilities, and a range of programs, that will deal with genetic engineering of microorganisms and cells, bioreactor design and process control, and product separation and analysis.

A graduate training program is a crucial adjunct to this effort. Programs in this field are very scarce nationally, and there is high demand for trained research personnel as new bio-based industrial processes approach commercial significance. Industry participation in and government funding of Institute programs is clearly predicated on the training of young scientists as well as on the research to be done. The presence of the Institute should make the MS program more attractive to potential students, and the presence of the MS program should make the Institute more attractive to faculty and industrial participants. By developing the two in concert, we should be able to build a program in this important new area that will make the University of Minnesota one of the top two or three centers nationally.

Sincerely,

Vic

Victor Bloomfield
Director

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Food Science and Nutrition
1334 Eckles Avenue
St. Paul, Minnesota 55108

July 1, 1983

To: Palmer Rogers

From: Joseph J. Warthesen, Director of Graduate Studies in Food Science JJW

Subject: Proposed Graduate Program in Applied and Industrial Microbiology

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Several members of our Food Science Graduate Faculty who have interest in the proposed Applied and Industrial Microbiology, Plan B Master's program have informally reviewed the program materials. We feel that the proposal outlines a very strong program with rigorous entrance and course requirements. The program seems to fulfill a growing need in this emerging area of microbiology.

Although some of our Food Science faculty and graduate students are involved in microbial genetics activities, we do not foresee any conflict or unnecessary overlap with our Food Science program. Those of us who reviewed the proposal have no objections to the Applied and Industrial Microbiology program.

JJW/ pal

## Appendix B:

### Proposed Graduate Faculty in Microbial Engineering

| Rank | Faculty | Department |
|---|---|---|
| Professor | Arnold Fredrickson | Chemical Engineering |
| Asst. Professor | Wei-Shou Hu | Chemical Engineering |
| Professor | Edward Cussler | Chemical Engineering |
| Professor | Larry L. McKay | Food Science & Nutrition |
| Professor | Frank Busta | Food Science & Nutrition |
| Professor | Peter Chapman | Biochemistry & Microbiology |
| Professor | Stanley Dagley | Biochemistry |
| Asst. Professor | Janet Schottel | Biochemistry & Microbiology |
| Assoc. Professor | Joachim Messing | Biochemistry |
| Assoc. Professor | James A. Fuchs | Biochemistry |
| Asst. Professor | Dennis M. Livingston | Biochemistry |
| Asst. Professor | Gary Gray | Biochemistry |
| Asst. Professor | Howard Towle | Biochemistry |
| Asst. Professor | Florence Gleason | Botany |
| Professor | David P. Fan | Genetics & Microbiology |
| Professor | Irwin Rubinstein | Genetics & Cell Biology |
| Asst. Professor | Perry Hackett | Genetics and Cell Biology |
| Professor | Edwin L. Schmidt | Soil Science & Microbiology |
| Assoc. Professor | Ronald L. Crawford | Microbiology |
| Assoc. Professor | P. Patrick Cleary | Microbiology |
| Professor | Martin Dworkin | Microbiology |
| Professor | Anthony J. Faras | Microbiology |
| Professor | Beulah Holmes-Gray | Microbiology |
| Professor | Richard Hanson | Microbiology |
| Professor | Peter Plagemann | Microbiology |
| Asst. Professor | Patrick M. Schlievert | Microbiology |
| Assoc. Professor | James F. Zissler | Microbiology |
| Asst. Professor | Robert Wohlhueter | Microbiology |
| Professor | Charles Schachtele | Microbiology & Dentistry |
| Assoc. Professor | Bernard Reilly | Microbiology & Dentistry |
| Professor | Dwight Anderson | Microbiology |
| Asst. Professor | Robert L. Vessella | Microbiology & Surgery |
| Professor | Richard Estensen | Lab Medicine & Pathology |
| Asst. Professor | Harry T. Orr | Lab Medicine & Pathology |
| Professor | Leo Furcht | Lab Medicine & Pathology |
| Asst. Professor | Tucker LeBien | Lab Medicine & Pathology |
| Professor | John Staba | Pharmacognosy |
| Professor | Yousef Abul-Hajj | Pharmacognosy |

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Chemical Engineering and Materials Science
151 Amundson Hall
421 Washington Avenue S.E.
Minneapolis, Minnesota 55455
(612) 373-2300

6 July 1983

Professor Palmer Rogers
1460 Mayo Memorial Building
Box 196
University of Minnesota

Dear Palmer:

I have read the proposal of the Graduate Faculty in Microbiology to develop a new Master of Science degree program in Microbial Engineering. I approve of the concept and plan of the proposed degree, and I will be happy to serve as a member of the Graduate Faculty when the program is approved. Good luck on this endeavor!

With best regards,

Arnie

A. G. Fredrickson
Professor

AGF/st

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Urologic Surgery
Medical School
Box 394 Mayo Memorial Building
420 Delaware Street S.E.
Minneapolis, Minnesota 55455
(612) 373-8780 or 331-2261

August 3, 1983

Dr. Palmer Rogers
Department of Microbiology
Box 196 Mayo Memorial Building
Health Sciences Center
420 Delaware St. S.E.
Minneapolis, MN 55455

Dear Dr. Rogers:

I have received the proposed new Master of Sciences degree program in Microbiol Engineering and strongly endorse its implementation. Please rest assured that I will participate as a member of the Graduate Faculty and would welcome an active role in the program. As we have discussed in the past, I feel my area of expertise, tumor immunology/monoclonal antibodies, will have a relevant slot in the program core, and I will do whatever is possible to share some of my experience in this area. Incidentally, I would be quite receptive to a course incorporating the various aspects of monoclonal antibody generation, purification and utilization in the coming academic year if the other faculty members thought it would be of benefit. I have had a few calls from students requesting more instruction in this area than is currently provided.

I agree with many of the outside reviews regarding the program that practical experience in the proposed "bio-tech" areas is essential. If a course in Monoclonal Antibodies is to be offered a dynamic, hands-on, laboratory should accompany the lectures.

Feel free to call me at any time regarding these matters or others in which my participation might be of some value. You may reach me at 725-6767, ext. 6661 and I would be pleased to meet with you on campus or simply discuss them by phone.

Sincerely yours,

Robert L. Vessella, Ph.D.
Assistant Professor

UNIVERSITY OF MINNESOTA
TWIN CITIES

College of Pharmacy
Health Sciences, Unit F
308 Harvard Street S.E.
Minneapolis, Minnesota 55455

June 24, 1983

Dr. Palmer Rogers
Dept. of Microbiology
1460 Mayo, Box 196

Dear Palmer:

I have read the proposal for the graduate program in Microbial Engineering and find it to be adequate. I am sure that with time we may have to modify the curriculum to fit the needs of the students.

I certainly approve of the concept and plan of the proposed program and would be willing to participate as a member of the graduate faculty.

Sincerely,

Yusuf

Yusuf Abul-Hajj, Ph.D.
Professor and Director
Graduate Studies in Pharmacognosy

YAH:rt

UNIVERSITY OF MINNESOTA
TWIN CITIES

College of Pharmacy
Health Sciences, Unit F
308 Harvard Street S.E.
Minneapolis, Minnesota 55455

July 7, 1983

Dr. Palmer Rogers
Professor of Microbiology
Box 196 Mayo Memorial Bldg.
Mpls. Campus

Dear Professor Rogers:

I have read the June 8, 1983 proposal for a Master of Science degree program in Microbial Engineering. I do approve of the project, and would be willing to be a member of the Graduate Faculty for the program.

Sincerely,

E. John Staba, Ph.D.
Professor

EJS:prn(I-107)

16M

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Laboratory Medicine and Pathology
Medical School
Box 609 Mayo Memorial Building
420 Delaware Street S.E.
Minneapolis, Minnesota 55455-0315

June 23, 1983

Dr. Palmer Rogers
Department of Microbiology
Mayo Box 196

Dear Dr. Rogers:

I reviewed your proposal for a Master of Science degree in Microbial Engineering. I believe your assessment for the need of such a program and a ready market for its graduates is correct. My reservation is in the area of the choice of Plan B rather than Plan A. I recognize that the Plan B allows a much broader training than the Plan A Master's degree. The Plan B degree will depend critically on the quality of laboratories involved and will be both labor intensive and probably expensive especially in regards to the costs of updating in equipment for the laboratory. The weakness of the program as I see it will be that we will not be able to evaluate the bench skills of any students in the laboratory nor will it demand what will be demanded of a student who had his or her own project. I would suggest that the Plan A Master's in addition to the Plan B be offered. I believe these students would be better prepared and certainly easier to evaluate in terms of bench skills.

A program with this kind of preparatory course work might well be integrated into your department's Ph.D. program which I think would offer an even greater opportunity for producing a skilled and a well-trained microbial engineer since both the course work and laboratory elements would be present at the Ph.D. level. I would serve on the faculty for this program.

Sincerely yours,

Dick

Richard D. Estensen, M.D.

RDE:dj
enc.

UNIVERSITY OF MINNESOTA
TWIN CITIES

Department of Biochemistry
Medical School
4-225 Millard Hall
435 Delaware Street S.E.
Minneapolis, Minnesota 55455

July 7, 1983

Professor Palmer Rogers
Department of Microbiology
1460 Mayo Memorial Building, Box 196

Dear Dr. Rogers:

After reviewing the material on the proposed Master of Science program in Microbial Engineering, I have concluded that the program would be of benefit for students and the University.

I would be willing to participate as a member of the faculty. My only reservation in doing so is that my own interests are in basic research and not in applied techniques. Whether I will be of any value to your program I cannot judge.

Sincerely,

Dennis Livingston

Dennis Livingston
Associate Professor

DL/mh

UNIVERSITY OF MINNESOTA
TWIN CITIES

Immunobiology Research Center
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Medical School
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Minneapolis, Minnesota 55455
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August 11, 1983

Dr. Palmer Rogers
Department of Microbiology
Box 196 Mayo

Dear Palmer:

This note is in response to your letter concerning the proposed M.S. program in Microbial Engineering. I support the concept of a M.S. degree in Microbial Engineering and would gladly participate as a member of the Graduate Faculty.

Sincerely yours,

Harry T. Orr, Ph.D.
Assistant Professor

HTO/jg

These make an appendix C

# FINAL WORD/

by David Pramer, Ph.D.

## ENSURING QUALITY EDUCATION IN BIOTECHNOLOGY

Biotechnology is certainly not new. It was practiced by ancient man for the production of fermented food and beverages, and gained prominence during World War I when acetone and glycerol were produced by bacteria and yeast, respectively, for the manufacture of munitions. These processes led after World War II to the development of an important fermentation industry responsible for the production of penicillin, streptomycin, and other therapeutically important antibiotics. Fermentation technology now is used to produce enzymes, amino acids, and various other metabolic products of microorganisms on a commercial scale. This important evolutionary development over the decades went almost unnoticed until the 1980s, when the rubric biotechnology suddenly emerged as a major concern of science and society. The current focus of interest on biotechnology results from a number of developments, including the search for alternatives to fossil fuels caused by escalating energy costs, the protein shortage so evident in developing regions of the world, the development of new fermentation equipment and bioreactors with enhanced industrial potential, the improvement of cell-culture and cell-fusion techniques, and, finally, the much publicized development of recombinant DNA procedures capable of programming bacteria and other cells to make things they have never made before.

Biotechnology is a challenge that educators cannot ignore. However, today's biotechnologists were not trained as such. They came mostly from traditional fields of science and technology with individual training in biology, chemistry, or engineering. Together, they have labored to build interdisciplinary bridges, constructing centers of intellectual activity where novel processes and products are created for the benefit of human health and well-being. All this brings a new luster to a career in research, making universities more attractive to many of this country's most promising young people. However, when those answering the call arrive as students at the schools of their choice, it is doubtful that they will be able to locate a program in biotechnology.

Biotechnology may be defined as the utilization of microbial, plant, or animal cells, or their constituents, to provide goods and services. Biotechnologists must learn the practical side of science. They must practice science as a skill, and to do so they must be skilled scientists. Therefore, it would be unwise for universities to offer educational programs in biotechnology that are narrowly conceived or overly professional, and it is essential for university scientists within traditional academic disciplines not to abdicate a responsibility to educate biotechnologists.

It has been estimated that more than 35,000 biotechnologists will be needed in the U.S. by the end of this century, but research universities deserving of the name should be interested more in quality than in quantity. They should not sacrifice long-term benefits for short-term gains. In the past, some universities explored new organizational approaches and novel interactive relationships for cross-disciplinary programs of education in environmental science, space science, cancer, crime, and energy. That experience can be used to advantage now to design programs in biotechnology.

Biotechnology is a labor-intensive, science-based industry, and biotechnologists require quality education in the sciences. The industry was created by university graduates with degrees in chemistry, biology, and engineering. To continue to flourish, biotechnology must be nourished by a steady supply of individuals who also are well educated in traditional disciplines, and who are taught a respect for the application of science as well as for science itself. Since biotechnology five years from now may be quite different from what it is today, the key to educating a biotechnologist is flexibility in specialized aspects of a program that is firmly based in science and engineering.

Within a university setting, separately organized research centers have served successfully as vehicles for faculty members to pursue professional interests beyond the constraints of traditional departments. They facilitate cross-disciplinary cooperation for the solution of problems of intellectual and societal importance and introduce diversity into institutions of higher education. Separately organized research centers maximize visibility and enhance institutional prestige, making the university more attractive to scholars, to undergraduate and graduate students, and to funding agencies. They are a major device employed by leading universities to conduct training and research in areas like biotechnology which are deserving of special attention and priority. A separately organized biotechnology research center would be able to forge educational programs appropriate for training predoctoral and postdoctoral students and it could function also as a source of continuing professional education.

David Pramer, Ph.D.

Students associated with the center should study a chosen discipline in depth and complete the requirements for a degree with a major in an area such as biochemistry, genetics, microbiology, or chemical engineering. In addition, students should be awarded a Certificate in Biotechnology in recognition of their participation in a selection of special educational offerings designed as an introduction to biotechnology. A joint seminar is one way to acquaint students with the difficulties of communicating across disciplines and to teach the importance in biotechnology of interdisciplinary literacy. Of equal value would be a special topics course that familiarizes students with the principles

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David Pramer, Ph.D., is Director of the Waksman Institute of Microbiology, Rutgers University.

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# Expansion in Biotechnology

The Research and Development Division of G D Searle at High Wycombe has a major commitment to biotechnology, particularly the application of recombinant DNA techniques. In its related programmes the Company currently employs over 80 Molecular Geneticists, Fermentation Technologists and Protein Chemists. Due to continued expansion of our efforts in this field the following vacancies have arisen.

## Protein Chemist
### (Immobilised Enzymes)

We are seeking an Enzymologist/Protein Chemist with 5-10 years post-doctoral experience to initiate studies on the use of immobilised enzymes in synthetic processes. We envisage that the successful candidate will have considerable expertise in both enzyme immobilisation and protein purification. He/she will be closely affiliated with the existing Protein Purification Group but will also be expected to interact with the Fermentation Research Group. This is a senior appointment and the conditions of employment may include a company car. Ref. PR35.

## Fermentation Technologist

We are seeking a graduate Fermentation Technologist to assist with the production of Pharmacologically active compounds from recombinant microorganisms. The work will involve the development to pilot scale of genetically modified strains and will necessitate close liaison with other groups, particularly Bacterial Geneticists.

Candidates preferably should have 1-2 years experience in a fermentation laboratory. Ref. PR17.

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Send a detailed c.v. or obtain an application form from Mr C G L Jenkins, Personnel Manager, Searle Research and Development, Lane End Road, High Wycombe, Bucks. (Tel: High Wycombe 21124, ext 3374). Please quote appropriate reference.

SEARLE

## CALIFORNIA BIOTECHNOLOGY INC.

Cal Biotech invites applications from molecular biologists at all levels of experience with a Ph.D., M.S., or B.S. degree. We seek highly motivated individuals with training and experience in recombinant DNA technology including gene isolation, sequencing, and expression, in protein chemistry, or in other related fields.

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**Dr. Brian J. McCarthy**
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## MICROBIOLOGISTS

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Martin Marietta Laboratories
1450 S. Rolling Rd.
Baltimore, MD 21227

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