INTRODUCTION

This report is the result of an external review of the Department of Biology, Vanderbilt University, conducted February 1-3, 1998. The review committee consisted of H. Craig Heller, Stanford University, Leslie A. Leinwand, the University of Colorado, Douglass H. Morse, Brown University and Barbara A. Schaal (committee chair), Washington University. The committee spent two days touring departmental facilities and meeting with faculty, administrators, graduate students and undergraduates. The persons we met with were candid in conveying their opinions on the current state of the Department and they all strongly expressed the hope that this external review would be the beginning of substantial improvement in the Department. Our review is necessarily the result of a brief visit and the impressions that emerged during that time. We realize that the issues facing the Department are more complex than can be fully appreciated during a single visit and we hope that our recommendations will be viewed with this in mind.

Biology is emerging as the central science of the next decades. Our understanding of the basic life processes is increasing at an exponential rate and this understanding has fueled dramatic advances in medicine, agriculture, and biotechnology. Biology has assumed leadership in American science, and Biology should be in a leadership role at Vanderbilt University. Our review uncovered several strengths in the Department of Biology that could serve as the nucleus for building a strong, world-class department, but our review also identified obstacles and weaknesses that currently prevent the department from realizing this potential.

I. DEPARTMENT OF BIOLOGY AT VANDERBILT

A. Department Structure

1. Size: The Biology Department is small considering its mandate and its role in undergraduate education at Vanderbilt. It consists of 7 professors, two associate professors, and four assistant professors. Its mandate is to cover all of biology from the cell level up, and it serves a large, mostly pre-professional undergraduate student body. More than any other area of science, biology has grown enormously over the past couple of decades, so to even attempt to cover such a broad field with such a small faculty creates an impossible situation. The problem is made worse by the fact that only 6 faculty have maintained funded research programs over the past 6+ years. This does not take into account the one well funded assistant professor who was denied tenure and the fact that two assistant professors have not yet been on the faculty long enough to establish their laboratories and obtain funding. It is likely that in the next year or so, 8 of the continuing faculty will have active, funded research programs. These and other circumstances have made it impossible to establish a coherent, high quality graduate program. If the research programs in the department were focused in one or two areas, there would be the basis for a graduate training
program, but they are not. This makes it very difficult to attract high quality graduate students that would catalyze the research programs of the department. Thus, even though the faculty who are active in research are productive, doing good work, publishing at reasonable rates in good and some excellent journals, it will continue to be an uphill battle for them to maintain vital research programs that will continue to attract funding, graduate students, and postdoctoral fellows. In addition, it is almost impossible to expect that this Department could offer an undergraduate curriculum of sufficient breadth and content to serve adequately a large, pre-professional student body.

2. Disciplinary Focus: This department had its origin in the early 1960's when the existing department was split into a Department of General Biology and the Department of Molecular Biology. The Department of General Biology was renamed the Department of Biology only about 6 years ago. Although this split may have made some sense in the early 1960's when molecular biology was in its infancy, it makes absolutely no sense today, and this artificial distinction contributes significantly to the problems of the current Biology Department. The past 10 to 20 years have seen an enormous revolution in the biological sciences that has drastically changed the nature of the profession. Two important changes in the biological sciences have taken place and have irreversibly altered what it means to be a biologist and to do biological research. The current structure of the biology departments at Vanderbilt makes it very difficult to take advantage of these changes.

The first change is that molecular biology has produced sets of tools that are now in common use across many subdisciplines of biology. As a result, the historical distinctions between cell biologists, geneticists, immunologists, developmental biologists, biochemists, and physiologists have broken down. The nature of cutting edge research is multi-disciplinary. Although biologists working at the cell, molecular, physiological, ecological and evolutionary levels still ask different questions, they no longer have unique sets of tools and approaches. They can share extremely powerful tools that develop and change rapidly.

The second change confronting the biological sciences is the information explosion. The amount and the quality of the information that is now being produced in our field is enormous and growing exponentially. Thus, it is harder to keep up in increasingly narrow areas of specialization. At the same time, the likelihood of breakthroughs in other areas relevant to our own work increases. This is true of methodologies and it is also true of mechanisms. As we learn more and more about the molecular biology of different systems and different organisms, we find increasingly more points of commonality. It is therefore essential to try to build departments that provide opportunities for interactions between what had previously been considered nearly autonomous subdisciplines of the biological sciences.

Thus, the situation at Vanderbilt where "molecular" biologists are separated in one department but cell biology, developmental biology, genetics, and physiology are expected to be covered in another department makes no sense. One could argue with some justification that neurophysiology still has its unique sets of approaches and that ecology and evolution are less dependent on molecular tools. Yet, exciting breakthroughs in neurobiology result from the combination of molecular and electrophysiological approaches, and increasingly, molecular tools are proving of value to evolutionary biologists. There are schools with much larger populations of biologists that have organized in divisions broadly along the lines of Cell/Molecular/Developmental and Organismal/Ecological/Evolutionary. However, at Vanderbilt the small number of faculty in the biological sciences makes such a division unnecessary and non-productive.

3. The Faculty: In its self-study, the department identifies four focal areas of expertise and research: neurobiology and circadian rhythms; plant physiology, anatomy, and taxonomy; parasitology and immunology; and ecology and evolutionary biology. In reality there
are only two functional areas at present. With the loss of Dr. dePamphilis there is little remaining research activity in the area of plant biology. With respect to parasitology and immunology, there are no individuals in the department who would be considered immunologists, and Professor Bogitsh is close to retirement and not active in research. That leaves Dr. Carter who leads an active research program in parasitology and the recent recruit Dr. Zweibel who is beginning to work on *Anopheles* mosquitoes but is really more of a molecular biologist working on insects than a parasitologist.

The two research areas that do have reasonable strength are: neurobiology / circadian rhythms and ecology / evolutionary biology. The former group includes two excellent and active circadian researchers, Dr. Page and Dr. Johnson, and an insect neurobiologist, Dr. Honegger. Dr. Dean will add neurobiological strength as he builds his program in the department. The visiting committee did not have the opportunity to meet with Dr. Dean, and from his curriculum vitae it is difficult to accurately ascertain the nature of the research program he will build. It appears that it will be oriented towards biomechanics and modeling of neural networks, and not molecular/cellular neurobiology. It is also an advantage that Dr. Zweibel, the recently hired molecular biologist, has considerable past experience and achievements in the molecular biology of circadian rhythms. Evolutionary and evolutionary biology is represented by Drs. Polis, McCauley and Pellmyr. Although a small group, they are complementary, productive, and highly interactive focusing on plant/insect interactions and community ecology.

It was clear to the visiting committee that there was a low morale and a serious sense of despair among the faculty. The denial of tenure to Dr. dePamphilis was one obvious and immediate cause, especially among the ecology and evolutionary biology group. More broadly, however, there was a sense of lack of commitment of the administration to the health and growth of the department. The present physical facilities are a very serious problem and therefore the false start on a previous plan to remedy that problem was dispiriting. Another factor contributing to the low morale of the junior faculty especially is the lack of an attractive graduate program that would provide for them first rate candidates for graduate study. Besides the provision of new facilities, growth of the department will be essential to retain the best young faculty and to nurture their research careers.

In summary, the department has two strong areas to build around: neurobiology and biological rhythms, and ecology and evolution. This is rather slim for a department that is supposed to represent all of biology above the cellular level. The holes are many -- plant cell/molecular biology, developmental biology, animal cell biology, genetics to name a few obvious ones. It is also remarkable that there is no one in the Department who works on vertebrates, let alone mammals. For a department that must serve the needs of a largely pre-medical population of undergraduates, this is a serious deficit. The Department has made excellent appointments in recent years, and therefore has a good foundation on which to build. It is urgent that the building of the Department begin immediately, however, or the current problems will erode the foundation that has been laid. To develop the research programs of the junior faculty, the facilities must improve, the graduate program must be strengthened, and they must have a critical mass of research-active colleagues with which to interact. These problems interact synergistically; therefore, decisive action must be taken on all fronts if Biology is to be strengthened at Vanderbilt.

B. Recommendations

1. Strategic planning: The visiting committee recommends that strategic planning be initiated for the purpose of creating a new and modern Department of Biological Sciences at Vanderbilt. This new Department should incorporate the existing faculty of the Biology Department and the Molecular Biology Department along with a number of new appointments in critical areas. The new Department of Biological Sciences should be housed together in new space that is designed and built to support the research programs of the Department. Such a bold approach will require difficult decisions, and therefore the strategic planning should involve outside leadership. That
leadership could take the form of an advisory board that would include representatives from the present departments and at least one representative from the basic sciences in the Medical School. The chairman of the board and the majority of its members, however, should be highly respected biologists that have had the experience of leading broadly based departments at other institutions, and they should be representative of a broad set of subdisciplines of biology.

The charge to the Strategic Planning Board should be to design a new Department of Biological Sciences that takes into account the existing research strengths of the present two departments and proposes specific areas for new appointments that will produce a department that: 1) adequately covers essential areas of modern biology, 2) has focal areas of excellence constituted so that groups of faculty are maximally interactive because of shared problems, methodologies, or model systems, 3) that complements areas of strength in the basic science departments of the Medical School, 4) that can offer a superb curriculum and research opportunities for undergraduates, and 5) can create a highly attractive graduate training program.

2. Short term steps: The visiting committee recommends that a number of short term steps should be taken to strengthen the department and retain the research active faculty who are actively seeking other opportunities. Whereas incremental billets should be made available to implement the recommendations of the Strategic Planning Board, the present billets within the department should be used to their full advantage to maximize current strength and to minimize the delay that will inevitably result from initiating a strategic planning effort and the creation of new facilities. The administration should be willing to release the Nunnally billet and to mortgage the Bogitsh and Wittier billets to enable searches that will fill obvious holes in the department and strengthen existing groups. At least one of these appointments should be made at the mid-career level, and every effort should be made to identify female and minority candidates. Areas that could be addressed in these searches and would be required in a new Department of Biological Sciences include: plant cell/molecular biology, developmental biology, cellular/molecular neurobiology, and vertebrate physiological ecology. The promise of being able to participate in the growth of a new department and the planning of new research facilities should enhance the recruiting ability of the department in spite of the obvious current problems described above.

3. Leadership: The Department of Biology has been fortunate to have consistent, dedicated leadership for such a long period under Professor Clint Carter. He has maintained a balance and a spirit of community in the Department that seems to be genuinely appreciated by all of the faculty. The visiting committee believes, however, that to achieve the radical changes that are necessary to strengthen this department and to lead its participation in the creation of a new Department of Biological Sciences, new leadership is needed. This may be a good time to recruit a new chair from the outside with the promise that the new chair would be a leading player in the planning of the new department and new facilities. Whether the new chair is from the outside or inside the present department, it should be clear that he or she will also serve in the new department, either as chair or perhaps as head of an internal division. However, the selection of the chair for the new department will be the responsibility of the Strategic Planning Board.
II. GRADUATE PROGRAM

A. Current Program

It is essential that any biology department at a major research University such as Vanderbilt have a strong graduate program. Leading biology departments are characterized by an active faculty engaged in teaching and research. Central to these activities is a cadre of outstanding graduate students who conduct research, provide intellectual stimulation, and serve as teaching assistants and undergraduate research mentors. The current small Biology Graduate Program has numerous aspects that make it less than adequate. The Review Committee felt that the current students are underpaid, have excessive teaching loads, have an unfocused graduate curriculum and are burdened with a requirement for too many formal classes. In fact, it was amazing to the committee that the Department is able to attract competitive students at all. It is a testimony to the quality of some of the research faculty that they are able to attract students directly. The number of graduate student applicants is very small. In addition, the attrition rate of graduate students is unusually high. In speaking with the students and faculty it became apparent that the attrition was largely due to the better students transferring to other Universities.

1. Teaching: Most students serve as teaching assistants for the duration of their graduate careers, teaching 5 sections per year. This excessive amount of teaching, while meeting the demands of the introductory course, is at the expense of the graduate student's own education. Moreover, because of the enrollment demands in the introductory sequence, graduate teaching assistants have little flexibility with respect to what course they teach; most students serve as teaching assistants only in BioSci 110. Both graduate and undergraduate education would be well served by diversifying the teaching experiences of graduate students.

An issue relating to teaching assistant training was raised during our meetings with graduate students. Although the committee was told different things about this program by the students and by the Administration, there is a clear perception (justified or not) by students that the requirements for teaching assistant training are greater for foreign born students, regardless of their command English and teaching experience. Obviously, there should be a mechanism in place that a student could "place out" of such training and the nature of this program should be clarified to the students.

2. Curriculum: Because of the small faculty size within the Department and the great demands of the undergraduate major, the faculty does not have the time to offer formal graduate courses. Thus, there is essentially no graduate curriculum. Yet, the graduate students are required to take 24 hours of formal classwork. Graduate students expressed the opinion that they must search around for advanced undergraduate courses and while the courses are often interesting, they are not relevant to their specific research or area of interest.

3. Stipends and Support: There is a differential teaching assistant stipend for the Biology Graduate students (lower) than for the Molecular Biology students. This is undoubtedly demoralizing to the Biology Graduate students. The issue of summer support for Biology graduate students is critical. Graduate students usually don't have summer stipends so that they stretch their 9 month TA money over 12 months. Thus, at a financial level, the graduate program in Biology at Vanderbilt is non-competitive with many other Universities. A final point relates to support for students from research grants. Very few of the faculty put stipend slots on their research grants, so that some students even in relatively well funded laboratories are still required to teach at these intense levels. On the other hand, we wish to point out that several of the faculty are funded by NSF programs that give grants of only modest size. One cannot expect these grants to carry the burden of graduate student support.

4. Advising of Graduate Students: It appears that there is not adequate attention paid to regular committee meetings for graduate student advising. Our impression was that the students are
B. Recommendations

In order for the graduate program to improve to a level equal with most research Universities, major changes need to be made that will require investment from the Administration as well as efforts on the part of the faculty.

1. Reduce teaching loads: It will be impossible for this program to mature into a solid, competitive graduate program until the teaching loads are reduced. The amount of teaching required of graduate students is so high as to make the review committee wonder how students have any time to do their research. There are several possible mechanisms for reducing teaching loads. The committee feels that all should be implemented. First is to redefine what constitutes a teaching assistantship. The normal load of 5 sections is very high compared to the usual levels required at the institutions represented in the Review committee (usually 2 sections). Second, would be to have the Administration invest in the program by providing research assistantship stipends for the incoming class for 1-2 years to allow the faculty to begin obtaining slots for student support on their research grants. Third, the faculty should write training grants for graduate education. Several possible avenues are or will be available. A new department of Biological Sciences that combines the current two departments would be competitive for NIH or NSF training grants in several areas. The U.S. Department of Education has the GAANN program (Grants Applied to Areas of National Need) which is also an avenue of support.

2. Stipends should be equalized: The stipends of the Biology and Molecular Biology students simply cannot be different. Since the IGP sets the stipends for their entire program, the administration should provide the difference to the Department of Biology until some other source of support can be obtained.

3. Reduce/restructure course requirements: Given that many of the students participate in journal clubs and group meetings, the possibility of assigning credit to these real learning experiences should be explored. Graduate courses should be developed and some could certainly be jointly taught with Molecular Biology. The development of a truly active and vibrant graduate program can not occur until the Department hires additional, research active faculty that add to both the undergraduate and graduate course offerings.
III. UNDERGRADUATE PROGRAM

The mission of the Department includes excellence in undergraduate education. The Department and the faculty recognize a strong responsibility for teaching undergraduates and are proud of the program and the capability of the students who take their courses and major in Biology. A high proportion of these students are bound for professional school, especially medicine and dentistry, but smaller numbers follow several other tracks, including graduate school. Teaching responsibilities in the Department are heavily oriented to undergraduate courses.

A. Curriculum

The Department attempts to offer a broad curriculum, covering much of biology, except for molecular and related areas, which are covered by the Department of Molecular Biology (MB). Teaching collaborations with MB have increased in recent years, and several courses are now offered jointly by faculty in the two departments and cross-listed. Teaching efforts currently are dominated by the Department's (along with MB) commitment to a two-semester introductory course (BioSci. 110a,b), required for all majors in both Biology and MB. This course compromises the Department's ability to offer other critical courses. Further, it is now given in two separate lecture sections, automatically doubling the lecturer needs and lessening the availability of faculty for the rest of the curriculum, or for providing teaching relief. Halving the lecture size does not accomplish pedagogical goals possible only in an intimate setting. Vanderbilt must have rooms that can accommodate classes of 350. The faculty hours gained could otherwise be profitably used for other parts of the curriculum. The demand for staffing BioSci. 110 laboratories with teaching assistants also restricts the availability of assistants for other courses. Further, the introductory courses for non-majors (Bio 100 and 101) should be offered once a year while the Department is experiencing difficulty in accommodating its own curriculum.

Both Biology and MB have expressed considerable pride over 110. Certainly many strong things can be said for such a sequence - biologists of every stripe profit from a broad basic background, and the course also has had the salubrious effect of fostering collaboration with MB, which helps to integrate the life sciences at Vanderbilt and reduce duplication of effort. However, reaction to 110 was mixed among faculty, graduate students and undergraduate students. Some faculty felt that the commitment to 110 strongly curtails the Department's ability to cover the curriculum, and the graduate students teaching in this course consider it to be widely perceived as a "flunk-out" course. We also heard this perception from some faculty members and undergraduates. The undergraduates' responses were mixed. They felt that the lectures were heavily oriented toward "throwing" large numbers of facts at them, to be regurgitated in multiple-choice examinations. Response to the laboratory part was more positive, but still mixed. Some felt that it was more heavily focused toward computer methodology than to the biology itself. Now that the course has been in place for several years, it seems an excellent time to scrutinize it carefully. The course is associated with higher MCAT scores (MB self-study), which satisfies a frequent concern, but is not a sufficient educational goal in its own right.

It seems open to question whether a weeding-out role (if not correct, widely perceived) for such a course is appropriate at a school like Vanderbilt. Biology is widely perceived as the science for the next century, and if so, should more be done to make the course a positive experience for most, at the same time maintaining the high standards that all courses should aspire to at Vanderbilt? Numbers of students enrolled in 110 and combined numbers of majors in Biology and MB are sufficiently disparate to indicate that a high percentage of enrollees in this course do not major in a biological science. Combined with numbers of majors and students in 200-level courses that are far below those at many other schools of Vanderbilt's size and goals, one is concerned about whether Biology is losing many prospective students at this stage.
The Department must make some important decisions about its curriculum. Even apart from BioSci. 110, it seems questionable whether the present faculty can provide an adequate offering, even though MB covers part of the biological sciences. The Department needs to provide depth in its offerings, for upper-class students as well as for graduate students. Although an impressive menu of courses is listed, many cannot be offered on a regular basis. The Department strongly, and appropriately, acknowledges its responsibility to provide an undergraduate biology curriculum for the University, keeping in mind its service function for preprofessional students. However, what basic curriculum is needed to serve the major constituencies? Vanderbilt clearly cannot be everything for everybody. The Department must answer this question, and it must be made in time to govern hirings anticipated during the next academic year. These will be crucial positions for the future direction and vitality of Biology and should not be made in the absence of a well-thought-out plan. Care will be needed to make faculty hirings able to help cover distributional needs, at the same time providing cutting-edge expertise in agreed-upon areas of concentration. Such candidates are not common, but they may be attracted to a school with a student body like Vanderbilt, and this approach seems most likely to succeed.

An evaluation of the curriculum ought to focus on opportunities for advanced study in selected areas, with suitable intermediate courses (e.g., physiology, ecology, evolution) offered on a yearly basis (ecology not offered in 1992 and 1994, evolution in 1993) and more specialized courses leading from them, offered, perhaps, in alternate years. Although several appropriate specialized courses currently exist in the curriculum, their potential sequential relationships would not be apparent to many students. Further, the content of these courses may need review. The offerings seem eclectic in some instances, and a more focused pedagogical approach may suggest modifications to the curriculum that would better serve the students. Such organization might highlight sequences of courses leading from introductory to intermediate to advanced. An arrangement that controlled the numbers of subdisciplines, but provided the opportunity for advanced work would provide an important educational opportunity, help to deal with realistically addressing the daunting breadth of biology, and facilitate optimal development of faculty critical mass. Given the ability of Vanderbilt undergraduates, such courses might provide some opportunities for graduate student training as well, though such a sequence could not adequately satisfy all graduate needs.

Many courses are greatly enhanced by field trips, but the College administration has traditionally been unsympathetic toward supporting these endeavors, both during the academic year and the summer. This attitude seriously detracts from both the value of the courses and the educational experience of the undergraduates.

The demand for courses could be eased somewhat by increasing coordination with MB. Students may currently use up to eight hours of MB credits in the 30 required for a Biology major, but few partake of this opportunity, even though it might enhance their program. A unified Biology degree should make such cross-registration more attractive to students - certainly the thought of a Biology student having little contact with genetics, development, molecular biology, etc., makes little sense at a time when integration among different areas of biology is occurring at an unprecedented rate.

The self-study expressed satisfaction with the undergraduate program, noting that the numbers of majors had grown markedly over the past few years, while rigorous standards and excellent teaching had been maintained. It concluded that the undergraduate program was in excellent shape and that the major task required was to monitor the program carefully and improve upon an already excellent teaching program. These self-satisfied statements concerned us somewhat. Numbers of Biology majors have burgeoned on many U.S. campuses over this period, also. Our impression of the undergraduate program is that it has a group of excellent, dedicated teachers; thus, the fundamentally most important part is in order. However, evaluation of the curriculum is very much in order to establish whether the faculty’s efforts are being used in the most effective way.
B. Undergraduate Research

Undergraduates frequently undertake research projects in faculty laboratories. The students whom we met were involved with research projects of their own and were highly enthusiastic about them. They were especially positive about the faculty-student interactions that they experienced and lauded the faculty for allowing them a high level of personal responsibility for their projects, but at the same time being extremely helpful. Faculty differ widely in their sponsorship of undergraduates in the laboratories, ranging from 0 to 5. The Department also has an Honors program, but enrollment in that program is limited, 2-3/semester. Enrollment in formal research (for credit) is also modest (averaging 13/semester, or about one student/faculty member), given the modest-sized graduate program. The research students we met were planning to go to medical school.

Faculty members also sponsor undergraduate research over the summer, supported by an institutional Howard Hughes grant, Vanderbilt funds, and Research Experience for Undergraduates (REU) funds. The REU funds have come as supplements to the NSF grants of four Department members. A few other students received summer support from faculty research grants. Several faculty make a strong effort to involve undergraduates in their research, especially in the summer, but the uneven distribution of these students across the faculty indicates that more opportunities exist. These opportunities provide important experiences for undergraduates considering graduate or professional schools.

C. Advising

Formal advising is centered in one faculty office, with one member taking broad responsibilities for the mechanics of advising. This is a time-intensive activity, requiring considerable technical effort that should be handled by a non tenure-track person, leaving the faculty in roles as true advisers, providing insight to students on academic issues, rather than dealing with paperwork. This point is not to devalue advising, but to concentrate faculty time on the unique aspects of the process, which only the faculty can in some instances provide.

The faculty recently in charge of the program have not been heavily involved in other leadership activities of the Department. Unfortunately, the current director did not, in our minds, present what is important and exciting about biology. We question how many students would be encouraged to major in biology as a result of their first official image of the Biology hierarchy. This office should be supervised by a faculty member who enthusiastically conveys the excitement of biology today. At the same time it is vital that this person not be saddled with all of the administrative detail assumed by the present undergraduate director. A support person might be shared with MB, especially if a joint undergraduate major were offered in the biological sciences. The support person would handle the logistics under the supervision of the Faculty Director, but the responsibilities for curricular advising of students would be distributed among faculty. On less formal issues, the undergraduates we interviewed expressed great enthusiasm for members of the Biology faculty whom they had engaged in questions related to courses, research, and other issues. They found these faculty to be friendly and helpful, and believed that these faculty valued and respected them as members of the intellectual community.

D. Enrollments

Enrollments in many of the courses is extremely low for a school of Vanderbilt’s size, with most of the students in the introductory courses. As an example, the basic course in ecology, potentially a gateway course into an ecology and evolutionary biology curriculum, enrolled only between 20 and 23 students and was only offered in three of the last five years. Comparable courses may attract five times as many students at some schools of similar size. Usually its high enrollment is...
associated with active environmental studies programs, as well as strong interests among biology students. We inquired about the presence of environmental studies at Vanderbilt and learned that it had never enjoyed a strong presence, either inside biology or elsewhere on campus. Such curricula draw substantial numbers of students at many schools, and we are left wondering whether the student body is fundamentally different from those of other schools, or whether a large, untapped reservoir of student interest exists on campus.

E. Majors in the Biological Sciences

Biology was separated into Molecular Biology and Biology (then General Biology) in 1963. Topical areas may have diverged enough to justify that split in 1963, but subsequent breakthroughs in molecular biology and related fields have served as powerful, integrating forces that have brought many formerly disparate areas together. These developments argue for bringing undergraduate biologists together into a single biological sciences major, perhaps recognizing areas of specialization. The two-semester introductory BioSci 110 provides students with a common foundation appropriate to basic biology. One such area of specialization in the Department is ecology and evolutionary biology, and the Department should consider others, based on the decisions it makes in anticipated approaching hires. Any such designations will necessarily require that the Department establish appropriate requirements, which may differ both in the biological science courses required, as well as supplementary science and mathematics. Recognition of specializations makes reorganization of the Biology curriculum (see Curriculum section) particularly important.

F. Coordination with the Medical School

The Medical School is a source of some possible faculty support that would augment current staff teaching efforts. Traditionally, the medical school has not interacted with Biology; however, we were told that the current medical administration is anxious to foster interactions with the rest of the University. The Department should explore the possibility that selected members of the medical faculty contribute to teaching in the undergraduate curriculum in areas of expertise. Although such efforts should not substitute for Departmental faculty, modest contributions in team teaching would permit some enrichment of the curriculum and foster interactions among the faculty involved. Careful efforts at certification must precede any such move, however. Further, since Medical School faculty will always have a primary responsibility to that program, the Department should not totally relinquish any essential teaching responsibilities.

Second, the laboratories of the medical faculty provide many opportunities for undergraduate research, an important educational resource not yet explored. The opportunities are especially attractive at Vanderbilt because the medical school is located on campus. More than 50% of the undergraduate research students from biological science departments at some comparable schools work in medical school or hospital research laboratories, thereby greatly increasing the number of students who can have a research experience. Medical School faculty conduct research in areas that interest a large proportion of Biology majors. Such relationships must be carefully monitored, especially when first implemented, but experiences elsewhere have been positive. This is clearly a major resource that Vanderbilt has not yet utilized. Since an undergraduate research project is a valuable capstone educational experience, and a definitive career-determining experience for many, the Department would greatly profit from fostering these interactions with the Medical School.

G. Recommendations

1. The Department should rationalize and streamline its current curriculum to permit basic courses to be offered in a timely fashion and to permit students into clearly-defined advanced courses. In particular, it needs to assess the magnitude of its commitment to three introductory courses, with
view of the need to provide advanced courses on a dependable basis. The expected new hirings must be carefully chosen to enhance the Department’s ability to make post-introductory courses available. Concern about BioSci 110 among various parts of the Department justifies evaluation of the course, if only to dispel current doubts. The Department should also encourage more undergraduates to become involved in research.

2. The Department should interact with appropriate Medical School groups to explore and facilitate possible teaching collaborations. In particular, undergraduate research should be encouraged in the Medical School laboratories.

3. Efforts should be made to create a single undergraduate major in the biological sciences, which could be designated with a few carefully chosen areas of specialization within the major.

4. The undergraduate advising scheme is inefficiently run, and the office needs to be reorganized. If a Biological Sciences major is established, it might permit adequate higher-level staff support to organize the technical aspects of arrangements and record-keeping, thereby permitting the faculty to concentrate on critical contacts with students. The faculty director would thus be spared the clerical responsibilities now part of the position. This faculty director should communicate the excitement and relevance of biology, thereby recruiting majors. The position should not be merely filled to assign work to research inactive faculty; it is far too important a position for that.

5. The undergraduate enrollments and majors in Biology are surprisingly low for a school of Vanderbilt’s size, and efforts are warranted to determine why this is so. Although the numbers of majors have increased at Vanderbilt, this trend is a national one, and several schools with comparable student bodies have three-four times the majors of Biology and MB combined, making them by far the largest majors on those campuses. Sustained enrollments at higher levels could in the longer term make an adequate argument for more resources and more lines.

IV. FACILITIES

A. Current Facilities

The facilities of the Department of Biology are acknowledged by faculty and administrators as woefully inadequate. Stating the obvious, the faculty of the Department cannot easily develop world class research programs in the fragmented and outdated facilities of Buttrick Hall. We are impressed with the ingenuity of the faculty in finding and modifying space for their research needs and in developing several distinguished research programs in spite of the current facilities.

Likewise, the teaching labs that we visited in Buttrick Hall were inadequate and outmoded. Given the quality of undergraduate education at Vanderbilt and the justifiable pride in the undergraduate program, the facilities for laboratory teaching are astoundingly poor. We assume that many undergraduates come from high-schools with better facilities.

The administration has plans to construct a new building that could house the current Departments of Biology and Molecular Biology. New space, outside of Buttrick Hall, seems to the review committee as the only reasonable solution to the overwhelming problems with the current facilities. Renovation of Buttrick Hall would be both an expensive and most likely, inadequate solution.
B. Recommendations

1. Unite the Departments of Biology and Molecular Biology in a single new building. Such a building would allow contact between the two departments and facilitate interactions and collaborations both in research and in teaching. The physical configuration of faculty in such a building could maintain established interactions and programs, while allowing new collaborations to develop.

2. Involve the faculty in the planning of the building to assure that teaching and research needs are met. A faculty committee should be convened to interact with the architect starting at the initial programming stage.

V. SUPPORT

A. Current Support

The department of Biology is currently understaffed. Our impression was that the split of biology into two departments has resulted in reduced staff support in each department to below adequate levels. As biology has changed over the last several decades, the staff needs of the departments has changed as well; the faculty expressed dismay that there is little staff help for computers. (All of us come from departments where there is at least one full time computer specialist on the staff.)

As the department increases its research profile in the future, the level of staffing will become an even more critical issue. Here we also see a benefit to merging the departments of Biology and Molecular Biology. A single large department can more easily afford to hire specialized support staff.

One minor issue of support emerged from our review.

We were surprised to learn that the Department of Biology receives none of the funds collected by the University for indirect costs from government grants. Many Universities have a program in place where some small fraction of indirect costs are returned to the department for research support. Such funds help maintain the research enterprise and provide additional incentives to the department for obtaining grants.

B. Recommendations

1. Evaluate staffing needs in a combined department of Biological Sciences.

2. Develop and implement a policy for indirect cost recovery for the Department
REPORT OF
THE MOLECULAR BIOLOGY EXTERNAL REVIEW COMMITTEE
VANDERBILT UNIVERSITY

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REPORT OUTLINE
VANDERBILT UNIVERSITY
MOLECULAR BIOLOGY EXTERNAL REVIEW COMMITTEE

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I. INTRODUCTION

The Molecular Biology Department at Vanderbilt University is an essential link between the College of Arts and Sciences and the Medical School. As such, it is well-positioned by virtue of its strong tradition in both research and education to play a leading role in the future of the University. In the course of the review and site visit, the External Review Committee (hereafter referred to as the Committee) gained a very favorable overall impression of the faculty, research, and educational programs of the Molecular Biology Department. The department faculty are committed educators, as well as active, well-funded researchers. Furthermore, there is a high degree of collegiality and goodwill in the department. Overall, we found the department to be in excellent shape, in terms of its administration as well as its research and educational programs. The Department Chair is a vigorous and effective leader and the Committee commends him for leading the excellent departmental self-study with which we were provided.

In the following report, we make a number of specific recommendations for improvement of departmental programs and the department's interface with other units on campus. Most importantly, we have considered the present status of the Molecular Biology Department as a free-standing unit and its potential role in the reconfiguration of Biological Sciences at Vanderbilt.

II. EDUCATION PROGRAMS

A. Undergraduate Programs

By all accounts, the Molecular Biology Department is doing a wonderful job in undergraduate education. The faculty are highly committed and, based on rankings, teaching prizes, and student feedback, do an excellent job of teaching both in classroom and laboratory settings. Funds raised from the Howard Hughes Medical Institute (HHMI) have allowed excellent new classroom and laboratory facilities to be built, and new courses to be designed and offered. The undergraduate curriculum offers an impressive variety of courses for such a small department. The Committee was also impressed by the success of the joint teaching ventures with faculty from Biology. Finally, there has been a significant expansion in opportunities for undergraduates to work in research laboratories of faculty in Molecular Biology. All of these successes should be valued at the highest level. As fellow teachers of undergraduates, we appreciate how much time, skill, and energy is required to do such an excellent job in undergraduate education.

The Committee was surprised to learn that undergraduates in Molecular Biology could not do research for credit in other departments or in the Medical Center. We understand that there are important issues of quality control here, but
these issues have been successfully addressed in many other undergraduate programs to the great benefit of the undergraduates. In addition, this would relieve faculty in Molecular Biology from the burden of having large numbers of undergraduates in their laboratories at the same time.

- The Committee recommends strongly and unanimously that Molecular Biology majors, with the appropriate controls, be permitted to do research for credit outside of the department. For many of them, this would improve their experience at Vanderbilt to an even higher level.

The Committee was also surprised to learn that one faculty member does almost all of the undergraduate advising. The Committee feels that this is inappropriate. General advising should be a distributed faculty activity. In our opinion, a distributed advising system gets more people involved and doesn’t overload one person. Under such a system it is still possible to have one person designated as the “go-to person” for detailed questions on policy, etc.

- The Committee recommends that the department re-evaluate the distribution of undergraduate advising duties and consider redistributing them.

The undergraduate honors students that the Committee spoke with were impressive and generally spoke highly of the education they had received. They felt that the Molecular Biology major was more difficult than the Biology major and had more prestige on campus. They complained, however, about several issues that should be readily correctable: repetition of material in upper-division courses that had been covered in lower-division courses, and a general lack of coordination of the curriculum. Several of the students felt that the Genetics course was not positioned well in the sequence of courses, coming as it does right after Introductory Biology, when students have no biochemistry. However, not all of the students agreed with this point of view. They also mentioned that they would prefer a problem-based approach in the freshman laboratory. They also commented that there is no formal mechanism for student input to the department; such as through a student advisory committee. This is perhaps the most important issue. The students seemed to have useful insights into the functioning of the curriculum that should be taken into account in the ongoing evaluation of the curriculum.

- The Committee recommends that the department consider setting up a formal student advisory committee or other mechanism for gathering student insights into possible improvements in the curriculum.
B. Graduate Programs

Individual graduate students in Molecular Biology were positive about their research laboratories and the research training they were receiving in these laboratories. They did, however, raise the issue of the Interdisciplinary Graduate Program (IGP) curriculum. A number of them stated that this curriculum is shallow and repetitive, and further, that the course offerings provided by Molecular Biology to supplement the IGP curriculum are limited. The first issue needs study; the second issue appears to be in the process of being corrected. We discuss the IGP program in more depth in a subsequent section covering the overall interaction of the Molecular Biology Department with the Medical School. As discussed below, the graduate students raised several other issues that were of significant concern to the Committee.

The Committee was very surprised to learn that many graduate students did not know or interact with other graduate students in the department or with faculty other than their advisor. By their account, there are few organized ways to interact with each other and they have little group input into departmental affairs. They also noted that social affairs are limited and low key and that there was no real off-campus departmental retreat. Unlike many departments, the graduate students in Molecular Biology apparently do not get to invite/host one or two seminar speakers per semester. We were told that the departmental seminar series was poorly attended by faculty, which sent a clear message to students that attendance was not important. In addition, they complained that the seminar series was often restricted to narrow topics, reflecting almost completely the research interests of the faculty member who organized them. Taken together, these issues raise serious questions about morale and cohesiveness in the department. The small size of the department should contribute to cohesiveness, but it is clear that some serious efforts need to be expended to achieve this goal. The departmental self-study suggested that their attractiveness to IGP students was limited by the quality of their space/facilities and the graduate teaching requirement. Our conversations with graduate students suggested that relatively low esprit de corps and cohesiveness are factors of comparable or greater importance.

The Committee recommends that the department consider instituting graduate student hosted seminars, a research retreat, and generally expand the opportunities for social interaction between faculty and students. This will require some faculty attention, but only modest financial resources, and has significant potential to make the department a more attractive home for graduate students.

Our conversations with the graduate students also raised concerns about their teaching experiences. Whereas, some faculty had raised the concern that the teaching requirements in Molecular Biology were a negative factor in recruiting IGP students, the students, for the most part, indicated that this was not a large factor in student choice of a department or research advisor. Some even indicated that the opportunity to gain teaching experience was a positive factor in their education. However, we were told that the graduate students often felt a complete lack of
departmental emphasis on the value of their teaching. Some students reported that their advisors made derogatory remarks or made it clear that they fundamentally resented the time and effort the students needed to invest in teaching. In a department that values undergraduate education and requires graduate TAs, this is a serious issue. The students also reported that some courses provide very little or no infrastructure, instruction, or faculty guidance for TAs, leaving them largely on their own to decide what and how to teach. The two-day, university-wide training sessions for TAs were viewed by many graduate students as a joke and a waste of time. In some cases, it seemed that the students did little real teaching in courses and were largely used as graders. The students also reported that they were not consulted about teaching assignments and consequently sometimes ended up teaching inappropriate courses, where they then received very poor evaluations from the undergraduates. These problems require immediate departmental attention.

- The graduate students should be provided with instruction by faculty in how to teach, and should receive serious input about their teaching performance. Asking the graduate students to rank different courses that they might teach in terms of their interests and abilities would undoubtedly lead to better matches. The use of undergraduate graders could allow TAs to do more real teaching. Showing departmental appreciation for TA efforts would probably go a long way. Many departments promote TAing as a way to develop organizational and communication skills that will be important whether they enter academics, industry, or other careers. With some more faculty effort, Molecular Biology could turn what may now be perceived as a minus into a plus.

An important issue with respect to the quality of the graduate program is the level of motivation of the students, which seemed mixed. Some students were clearly fully engaged and doing well, while others were already shying away from active research careers. By statistical measures, the average quality of the graduate students is not as high as in the best programs at other universities but the correlation between high scores and good scientists is marginal. The best graduate students in the department should be competitive for excellent postdoctoral opportunities. However, a significant number of the students we met did not have clear future plans and we did not find the record of placement of past graduates impressive compared to the best programs nationally.

We will take up the issue of the role of the IGP and its potential effect on the quality of graduate students in the subsequent section on the interface with the Medical School.

III. FACULTY RESOURCES AND RESEARCH PROGRAMS

Each member of the Molecular Biology Department has an active and, for the most part, well-funded research program. This is an impressive statistic in a national environment in which competition for research funds is intense. This
achievement is all the more impressive considering that high-quality graduate students and postdocs are in short supply in the department, and the faculty must commit a significant amount of time to undergraduate education both in the classroom and in the laboratory. The research breadth of the department is impressive given its small size. The faculty can be roughly divided into two research focus groups: Cell and Developmental Biology and Biophysical-Structural-Physical Biochemistry. Despite some polarization between the two groups, there is a lot of inter-faculty collegiality within the department. Few of the faculty are really "methods" people and all are interested in real biological problems, a clear strength. The Committee was also pleased to note that many of the faculty hired in the last decade have brought new research areas and strengths into the department. This indicates a healthy, forward-looking vision on the part of the department.

As noted in the department's "self-study", however, the Molecular Biology Department does not have a high national ranking. In part, this is a function of its small size. Many of the competing departments are much larger and there is a strong quantitative component to national rankings. However, it is also true that the overall research quality is not as high as would be expected in a "leading" department. The Committee acknowledges that this is a subjective conclusion but notes that the overall publication record of the faculty shows almost no papers in the very top tier of journals and, perhaps more significantly, a reasonable number of papers in third-tier journals.

• Because publication in the very best journals can be political, and somewhat unpredictable, a reasonable goal for self-improvement might be for the faculty to try to increase the fraction of papers published in "very good" to "excellent" journals.

Some senior faculty members expressed concern about their research programs and worried about their future ability to compete for funding. Such concern is both natural and healthy. Biologists today move in and out of research areas much more quickly than in the past and long-term funding of a single research problem is becoming rare.

• The Committee notes that faculty sabbaticals provide one opportunity for faculty revitalization and movement into new areas and was pleased to hear that the departmental and university administration concurs.

Several junior faculty expressed concern that their teaching loads were quite high and worried that this would impact on establishing their research programs at the level required for tenure.

• The Committee notes that many peer departments provide complete relief from teaching for junior faculty in their first year and often require only a half teaching load the second year.
We also believe that the overall teaching load for all faculty in Molecular Biology is higher than in many peer departments in other universities. On the other hand, Molecular Biology does provide teaching leave for one semester for junior faculty, which is rare in other departments. At Vanderbilt and many of its sister institutions, successful integration of teaching and research has always been a critical factor in evaluations for tenure. More recently, the ability to compete for research funding has also become an important component. As a consequence, junior faculty in Arts and Sciences departments must clear more hurdles during the tenure process than junior faculty in medical schools or other institutions with small or nominal teaching commitments.

- The Committee feels strongly that the uneven playing field in terms of faculty teaching loads in Molecular Biology vs. the Medical School departments needs to be acknowledged in the tenure process. One way to do this is to provide flexibility in the timing of the tenure decision by allowing extensions in appropriate circumstances.

- Several members of the Committee also felt the field could be leveled somewhat by advancing junior faculty to tenure as soon as it became obvious that they met the institutional standards. Another member, however, felt that early tenure should be reserved for those with very special credentials, for example as might be demonstrated by publication in first-tier journals.

Several junior faculty also commented on the lack of any formal mentoring of new faculty. It does appear to the Committee that a number of the junior faculty have had a difficult time in establishing themselves simultaneously as teachers and researchers and in balancing their many duties.

- The Committee recommends that the department seriously consider formal mentoring of junior faculty.

IV. INFRASTRUCTURE

The Committee notes with concern that the shared “core” facilities, such as autoclaves and other kitchen facilities, are in bad shape and need to be repaired, updated, or replaced. The details of these problems are clearly spelled out in the self-study document. The electron microscope facility was also mentioned as being in bad shape. The Committee concurs with the assessment of these facilities and the proposed solutions as detailed in the self-study document. However, the Committee heard no significant discussion of other types of facilities to which the best molecular biology programs nationally have access (i.e., biotechnology facilities such as DNA and peptide sequencing and synthesis, shared centrifuge facilities, monoclonal antibody preparation, animal facilities). The Committee questions whether these facilities are available (or are being planned) in the Medical School.
• The Committee notes that this is an auspicious time to submit shared instrumentation grants to NIH and NSF, an activity that should be carried out, where possible, across department lines, including with the Medical School. The University should consider encouraging this activity by providing matching funds for interdepartmental proposals.

Most importantly, the Molecular Biology Department's space in Learned Hall needs major upgrading and the laboratories in Stevenson Hall, which are adequate at best, also need some upgrading.

• The Committee recommends that the administration develop a concerted planed for the space occupied by the Molecular Biology Department. This will be a particularly crucial component of any discussions of reuniting the Molecular Biology and Biology faculties.

V. DEPARTMENT LEADERSHIP/ADMINISTRATION

Jim Staros has enormous energy and enthusiasm and he is a responsible leader and an effective fund raiser. Clearly, he is an extraordinary asset to the department. He has a very strong commitment to undergraduate education and has led the successful effort to obtaining funding for undergraduate education programs from the Howard Hughes Medical Institute.

The department seems to be reasonably democratic, but there are some strains in the general collegiality. As Chair, Jim Staros seemed to be somewhat overcommitted and has probably not had sufficient time to devote to the social aspects of the department that could go a long way towards improving collegial interaction (this is commented upon in the section on graduate students, as well). However, the Committee feels Jim Staros needs to be free to concentrate on leading the department in its scientific and administrative aspects, especially if negotiations proceed on a merger with Biology. Under these circumstances, he cannot be expected to lead all of these complex and crucial administrative negotiations and deal simultaneously with all of the interpersonal interactions of the faculty and students.

• The Committee suggests that appointment of an Associate Chair be considered in order to relieve the Chair of his presently overcommitted slate of responsibilities. We recommend that the Associate Chair concentrate on addressing the issues raised concerning the collegiality of the department, administration of undergraduate advising and teaching, and other issues that draw the Chair's time away from his leadership role within the University as it faces reorganization of the life sciences. It is also critical to the Molecular Biology Department that Jim Staros be able to devote sufficient effort to his own scientific program such that he retains his stature as a scientist, a vantage point that is crucial to his leadership.
The Committee also notes that numerous faculty mentioned the general lack of administrative and clerical support. One said, “The office is just terrible!” There is only one secretary and that person reports directly to the Department Chair’s administrative assistant. This arrangement is widely resented. The secretary is essentially taken up full-time on the work given to her by the Chair’s administrative assistant and the faculty are left with no secretarial support. This is another issue that an Associate Chair could deal with effectively, eliminating tension between the Department Head’s assistant and the faculty.

- The Committee recommends that reorganization of the office be considered and that the faculty be given some direct access to secretarial support.

There was also some faculty comment on the overcommitment (understaffing?) of the business office which handles all the grants. However, this situation seems to be improving with the implementation of a new financial management system and the Business Manager presented a convincing case that he had this situation under control.

VI. INTERFACE WITH OTHER UNITS

The Molecular Biology Department can be viewed as a triangle that presents faces to, and ultimately must interact with, the Medical School, Physical Sciences (Chemistry, Physics, and Engineering), and Biology. However, the research interests of the faculty in Molecular Biology are not uniformly distributed with respect to these three interfaces. Thus, the faculty in the areas of Cell and Developmental Biology make natural and comfortable interactions with the Medical School departments of Cell Biology, Physiology, and parts of Biochemistry. If problems of distribution of teaching effort, equivalence of quality of research space, and distribution of graduate students can be solved in a “seamless” way, the portion of the present Molecular Biology Department that interact with these facets of the Medical School faculty will prosper.

However, the situation is worse for faculty in the Biophysical-Structural-Physical Biochemical component of the present Molecular Biology Department. To varying degrees, the interests of this group are in the more quantitative ends of the Molecular Biology discipline. In most universities, faculty with such research interests have natural outlets for interaction and collaboration with colleagues in Departments of Chemistry and Physics. However, as we discuss below, there are significant problems with this interface at Vanderbilt.

Finally, there are, at present, few real interactions with the Biology Department except on the teaching level. Clearly, there are strong institutional reasons to consider uniting the Molecular Biology and Biology Departments, as we will discuss below. However, this process will involve the integration of a department (i.e., Molecular Biology) that has been successful in terms of research support and interactions, collegiality and undergraduate teaching, with a department (i.e., Biology) with which there has been relatively little meaningful contact, or even outright hostility, in the past. The problem for the interface
between the Molecular Biology Department and the present Biology Department is problematic for another reason: there is really no critical mass of faculty in the present Molecular Biology Department who have major (present or potential) research interests that overlap with the present strong components of the evolution and ecology groups in Biology.

We discuss each of the three facets of the interaction of Molecular Biology with other parts of the University in turn, below.

A. Medical School

The Vanderbilt Medical School is an enormous and extremely productive research enterprise. It, of course, dwarfs Molecular Biology in size, containing greater than an order of magnitude more basic research scientists in half a dozen or more different departments. At the top of this group are some truly outstanding world-class researchers who are in large part responsible for the reputation of the Medical School. However, that said, if one compares research output on a size normalized basis, Molecular Biology would fare extremely well, comparable to the best of the Medical School departments. Especially given their heavy teaching loads, Molecular Biology faculty should be proud that their research programs overall are competitive, and this should be borne in mind in interactions with the Medical School. For example, it was the perception of the Committee that some faculty, especially senior faculty, felt they could not compete for the best of the IGP graduate students. This is not the case, and indeed statistics provided by the IGP Director suggest that this is untrue, certainly in terms of number of IGP students per faculty member in each participating department.

The Committee was pleased to learn that the administration at the highest levels of both the Medical School and Arts and Sciences are cooperating to improve interactions between the two schools.

- These improving relationships could be further fostered by providing more matching funds for joint grant proposals, seed money for promising but risky joint research projects, encouragement and support for a limited amount of undergraduate teaching by interested Medical School faculty, and lastly and importantly, rapid agreement upon the allocation of significant space for Molecular Biology faculty (or for faculty in a new Biological Sciences Department; see below) in a new Medical Research Building.

On an individual level, interactions between Molecular Biology and Medical School Faculty appear reasonable. For example, Dr. Staros, heads a joint Training Grant and several faculty described interactions or collaborations that are likely to be productive.

The largest interface between Molecular Biology and the Medical School is the IGP, and this is not without problems. A number of faculty (almost exclusively senior faculty) were dissatisfied with IGP (some considered it a “disaster”), and the self-study pointed out perceived flaws in the program.
While the Committee agreed that the IGP is less than perfect, its unanimous opinion is that Molecular Biology should continue participation in the program, working to increase its overall quality, and more specifically, the quality of students recruited to Molecular Biology. Indeed, some of the junior faculty are already doing quite well within the IGP framework.

Clearly, many faculty in Molecular Biology believe that participation in IGP has led to a reduction in graduate student quality and a redirection of students away from structural biology and biophysics. The first issue (i.e., reduction in quality) could not be confirmed or denied by the Committee. The fact of the second is difficult to deny (although several first year students are currently rotating in structural biology and biophysics laboratories) but the causality is uncertain. Some faculty, for example, told us that IGP did not accept students with strong physics or chemistry backgrounds but weak biology backgrounds, but the Director of the IGP labeled this “an absolute falsehood.” (We discuss the issue of strengthening ties to Chemistry and Physics as a way to attract more graduate students into the structural biology and biophysics component of the Molecular Biology Department in the following section.) However, it is clear that Molecular Biology now has less control over graduate student quality and areas of interest that it did before joining the IGP. Nevertheless, the Committee feels that withdrawing from IGP would be counterproductive.

The overall quality of IGP students appeared good to the Committee, but only a few would fall in the excellent category, and even fewer could be considered truly outstanding. This conclusion is based on statistics provided to the Committee both by Molecular Biology and by the IGP program, as well as on interviews with both students and faculty. However, again based on available data, the quality of students does not seem to have decreased significantly since the inception of the IGP. An important exception is the lack of foreign students. This problem must be addressed. The lack of foreign students admitted to the IGP is a particularly acute problem for those faculty in the quantitative areas such as Structural Biochemistry-Biophysics. Other universities recruit many of their students with strong quantitative skills from Asia and Eastern Europe. If the department is to increase its overall standing, it is essential that the quality (and to a lesser degree quantity) of students interested in Biophysics and Structural Biology be increased and that a way be found to admit a reasonable number of foreign students. While some aspects of the problem are discussed elsewhere (i.e., a possible parallel biophysics program), from the perspective of the IGP it is critical that Molecular Biology redouble its efforts to improve the overall quality of all the graduate students in the department. Given the competition with other programs in the IGP, this will be difficult.

One possible solution to the lack of foreign students and the paucity of students interested in the areas of structural biochemistry and biophysics might be to re-institute a separate admission of a few such students directly to Molecular Biology.

One area that may be deficient in terms of recruiting students to Molecular Biology is a credible presence of the department on the Web. (The Committee was
not provided with information on this, suggesting it may not be a high priority on the part of the department.) Given the exponential growth in the Web-based communication with potential students, this is rapidly becoming a necessity. It is also important that the Director of Graduate Studies play a forceful and dynamic role in representing the department's interests on the IGP Executive Committee. There was some concern that the Director of Graduate Studies may not be involved or as forceful as necessary.

- The Committee feels that a fairer arrangement for financing for IGP students is probably needed so that Molecular Biology does not have to pay for more students than it gets. However, such an arrangement would obviously work against the department if a large number of students chose Molecular Biology in a given year. Also, as mentioned in a previous section of this report, there are a number of things that Molecular Biology could do on a departmental level to make itself more attractive to graduate students. Also, we will discuss subsequently additional ideas about attracting more students with Chemistry and Physics backgrounds.

- The Committee also recommends that the IGP rule that limits laboratories to taking no more than three graduate students in a three year period should be revisited. Letting graduate students "vote with their feet" will, in the long run, make the program stronger.

**B. Chemistry, Physics, and Biomedical Engineering**

The Committee found it striking that no organized visits with Chemistry, Physics or Biomedical Engineering were planned for the Committee in advance of its arrival. The interface with the Chemistry Department seemed, to the Committee, to be the most impermeable and yet in the future, this interaction will be crucial for the more quantitative research and training programs within the Molecular Biology Department. Because no formal meetings were scheduled, the Committee got little direct first-hand insight into the interests or function of these entities.

- As a minimum, future external review groups for the Vanderbilt Chemistry Department (and perhaps Physics and Biomedical Engineering) should certainly schedule discussions with the Molecular Biologists, and future reviews of the Molecular Biology Department (or of an integrated Biological Sciences Department down the line) should certainly schedule discussions with the Chemists, Physicists, and Biomedical Engineers.

The conjectures concerning Chemistry that follow are based on what little the Committee was able to glean second-hand during the visit, coupled with the views of the Committee members of what a Chemistry program in a modern research university should be in terms of its interactions with a molecular biology program. Those on the local scene will necessarily have to figure out how many of these comments and suggestions actually fit Vanderbilt. What little we were able to learn...
directly about the Chemistry Department and its interaction with Molecular Biology came from interviews with a small number of Chemistry faculty available to speak with the Committee at short notice. We also heard from members of the Molecular Biology faculty about these interactions (or lack thereof) and from members of the administration. The picture that emerged was not encouraging. The fact that there was no discussion of present or future interactions with Chemistry in Jim Staros' self-study report, plus the fact that no meeting could be arranged (or had been arranged in advance) with the Chair of Chemistry, are consistent with these impressions.

If our impressions and information are correct, a picture emerges of a Chemistry Department that is very insular with respect to understanding either the importance of biochemistry and physical biochemistry in modern chemistry. Certainly, we gained no sense of appreciation of what the members of a modern Chemistry Department currently have to gain from interactions with the biological sciences. For example, we were informed that faculty members in both Molecular Biology and Chemistry had worked out the details of a proposed interdisciplinary biochemistry major, but that this proposal was not implemented due to lack of support at the highest levels in Chemistry. Certainly, the development of a biochemistry undergraduate major, either within the Chemistry Department or as a joint venture with a biology department with strong molecular biology components, could bring a large number of new undergraduates to the Chemistry Department. Furthermore, the development of a comparable interdisciplinary graduate program would have similar benefits. Such graduate students would form an appropriate "pool" to be drawn on by the quantitative biologists and the physical, organic, and inorganic chemists alike. This has now been proven to be true in most of the nation's leading research universities. In addition, the development of an active biochemical research component within the Chemistry Department or collaboratively with the biologists would allow access to the shared instrumentation programs of NIH and NSF allowing applications for equipment (such as NMR and x-ray equipment, mass spectroscopy facilities, laser, and spectroscopy laboratories, etc.), with immeasurable benefits for not only the biochemical researchers, but also for the other "pure chemistry" components of the Chemistry Department. This vision of the chemistry-biology interface is currently very much "in vogue", with training grants and facilities programs springing up everywhere. On the national level, this train "left the station" quite a while ago, and it is certainly time for the research community at Vanderbilt to "get on board". This, however, cannot happen without active cooperation and collaboration of the Chemistry leadership.

Chemistry is also an essential link between Biology and Physics. The best Chemistry Departments nationally have committed ca. 25% to growth in bioorganic, bioinorganic, biochemistry, physical biochemistry, etc. The Arts and Sciences College at Vanderbilt University needs a strong umbrella graduate program in biology/chemistry/physics with an interface to engineering that is not overshadowed by medicine. In most research universities a fraction of the people who are presently in the Molecular Biology Department would find themselves comfortably positioned in the biochemistry division of a modern Chemistry Department, and would draw most of their graduate students from a broadened Chemistry Department student pool. A partially redirected Molecular Biophysics
Training Grant could be used as a start in this direction, but such a training grant probably wouldn’t survive for long unless some real progress toward integration with Chemistry and Physics is made. This will be difficult or impossible to build and maintain without strong contribution from Chemistry.

- The Committee recommends that a major planning initiative be launched by the Dean to develop a better interface between Chemistry and Molecular Biology. Jim Staros is certainly well equipped, by training and disposition, to lead the molecular biology side of this planning component, but it is not clear whether his necessary counterparts are either “present” or “empowered” within Chemistry. If necessary, this might be the subject of a special external review, since Vanderbilt may need to get some advice in this area that is based on much more knowledge of the present Chemistry Department programs and personnel than we were able to glean in our tangential contacts.

Interactions between Molecular Biology and Physics at Vanderbilt seem much more promising than the interaction with Chemistry. Traditionally, the overlap with Physics on other campuses involves aspects of crystallography, perhaps NMR, and imaging, and perhaps mathematical biophysics. To the extent that these components of both departments exist, the individual faculty members involved have succeeded in forming at least informal integrated research interest groups. The Committee did not have the opportunity to review these interactions, but was told of the “Center for Biological Physics”. We were also informed of campus-wide interest in biophysics with graduate students coming through Physics and being supported on the Molecular Biophysics training grant. More of such activity should be encouraged in the future, but there seems to be no barrier to this activity at the administrative level in either the Physics or the Molecular Biology Departments. The Committee sensed active interest and engagement on the part of the physicists to participate in such activities. The Biomedical Engineering Department also seemed eager for more interaction with Molecular Biology. They would like to have a true double major with Molecular Biology and foresee opportunities for greater research collaboration in biomaterials, tissue engineering, etc.

- The Committee urges that these interactions with Physics and Biomedical Engineering be fostered, strengthened, and expanded, if possible, to include the Chemistry Department. We urge the administration provide support in the form of matching funds to encourage such interactions.

C. Biology

With some clear exceptions, interactions between Molecular Biology and Biology are sub-optimal. There is little in the way of existing common ground in terms of research interests. Perhaps some joint interests can be developed between individual members of the Molecular Biology and Biology faculties. Down the line a shared interest in quantitative issues of genomics, population biology, and molecular evolution may bring more members of these groups together, but
meanwhile tact and real mutual respect and tolerance will be required from both
groups. The two Departments have instituted a joint introductory biology course
that is co-taught, and by all accounts is outstanding. (Indeed, there is a very real
possibility that it is too successful, as the large number of students involved has
further stretched the Department's teaching load, which was already heavy.) One or
two faculty also described collaborative research projects with members of Biology,
but this was clearly the exception.

The major question with regards to the two Departments is whether
Vanderbilt is best served by having two relatively small Departments in Biological
Sciences. Vanderbilt was a pioneer 35 years ago when it split its biology in two,
recognizing the importance of Molecular Biology in modern science. Since then,
many universities have followed suit, and the current situation at Vanderbilt is
thus similar to that at many other institutions.

- It is the unanimous view of the Committee that Vanderbilt should once gain
  be a pioneer, this time in the reunification of its two Departments.

There are two principal reasons to move toward uniting biological sciences at
Vanderbilt. First, it is intellectually justified. The methods of Molecular Biology
have so permeated all areas of Biological Sciences (and even other allied disciplines)
that all sub-disciplines of the two Departments should benefit from interactions
with members of the other Department. Distinctions between “organismal” on the
one hand and “molecular” or “cellular” on the other are rapidly becoming dated,
and this trend is certain to continue, even accelerate. Second, neither Department
has truly flourished or reached its full potential since separation. Molecular Biology
is a solid department, but not among the top tier nationally, as it aspires to be, and
indeed should be. Biology, with some exceptions, is not strong, and the situation
shows signs of further deterioration. Reunification, if done correctly, will offer a
unique opportunity for a larger, reconfigured, new Department to flourish and
improve its standing.

Reunification, of course, will present many problems. One is that many
faculty (mostly Senior) in both departments appear to be opposed. In Molecular
Biology, the concern is that the department that is formed will be significantly
weakened, perhaps turned into a “teaching” department. However, these problems
are not insurmountable. While it is not within the charge of the Committee to
provide a detailed plan for reunification, we offer two broad suggestions. First, it is
imperative that joining the two departments should not be allowed to weaken
Molecular Biology or even be viewed within the University as having that effect.
This is critical not only for participating faculty, but perhaps even more so in the
eyes of colleagues outside Molecular Biology (e.g., in the Medical School). This
could, for example, scare off the best of the IGP students, a disastrous outcome.

- The administration must therefore make sure that any move toward
  unification is part of a plan to significantly strengthen Biology at Vanderbilt.
  This will require resources, not just words. Some possibilities: Funds for
  recruitment of one or more world-class scholars, perhaps in an area of
  strength in Biology, such as Molecular Evolution or Plant Biology; funds for
several additional graduate student stipends, to increase the quality and quantity of the student population (a Department of, say, 28 faculty should have at least 70-75 students to be competitive with the best departments nationally); and finally a firm commitment should be made to house a large fraction of the new Department in a new Medical Research Building.

- Second, reunification should not occur rapidly, but be eased in over a period of, say, four years. To oversee the transition, a committee should be formed consisting mostly of faculty (junior and senior) from both Departments, but with participation of Medical School faculty and external consultants as well. This committee should be charged with producing a well thought out strategy for what will in essence be a completely new Department, not simply the unification of two existing units.

- During the transition, all new hires should fit within the strategy for the framework of the emerging new Department.

- Both departments need to be involved in planning but decisions shouldn't be left to them or necessarily be democratic. The University will need broader strategic planning input for such an important change. It would be wise to include people from the Medical School Departments, as well. The new department will still be too small to cover all of modern biology and it is important to avoid the "Noah's Ark" approach. Decisions about what to include needs to build on current areas of strength and should attempt to complement not compete with the Medical School.

- While the above recommendations all involve additional resources, the University should be able to achieve offsetting savings by eliminating the duplication of administrative structures that currently exist in the two departments. Furthermore, efficiencies can be accomplished in the streamlining of curricular and teaching loads in the combined program. In the long-term, the cohesive planning that will result from the reunification will enable elimination of duplication in the areas of cell, developmental, and molecular biology resulting in a unified program having greater critical mass and cohesion than either single department could achieve. Additional savings should result from shared facilities, equipment, etc.

VII. STRATEGIC PLANNING FOR THE FUTURE

In the words of Professor Staros, the goal of the Department of Molecular Biology is "to become one of the best departments for its size in the country". A tall order, especially considering the problems and challenges that Molecular Biology faces over the next few years. But any lesser goal would have been disappointing, and not consistent with the possibilities offered by a top university such as Vanderbilt.

The Molecular Biology Department needs to strive for excellence in undergraduate education, graduate training and research, just like all of its peers.
With respect to undergraduate education, Vanderbilt is already there, and more. The undergraduate program in Molecular Biology is comparable to the very best in the country. But this has not come without a price. The teaching demands on the faculty are now so high that graduate training and research not only have failed to increase in quality, but perhaps have suffered.

- A goal must, therefore, be to maintain the undergraduate program while building graduate education and research. This is a significant challenge, but is essential if Molecular Biology is to increase its position amongst its peers.

- The overall quality of the graduate student population needs to be increased, their experience in the department needs to be strengthened, not only with respect to classes but also with respect to the student culture and cohesiveness, such that they are proud to be members of a top-notch research department.

- With respect to research, the department needs to strive to increase the impact and visibility of faculty research by more frequent publication in first and second tier journals. This is an extremely important goal if Molecular Biology wishes to increase its position amongst its peers, and must be encouraged from the Senior leadership of the department, both by example and by expectations. With respect to the latter, such honors as early tenure and promotion to Full Professor might carry the expectation of publication in top journals, as is common at the institutions with which Molecular Biology wishes to be compared.

- Finally, Molecular Biology must maintain, and even enhance, its standards in faculty recruitment. The department should be commended for its recent hires, for going after the best available and for venturing into new, important areas of biology. But the department must be careful not to let up, and it is important that it work to increase its standards further.

- The charge to this committee included a requirement to comment on those areas that can be cut. We have already indicated long-term cost savings that could be achieved by unifying Biology and Molecular Biology. Without such unification, we cannot recommend cutting Molecular Biology. It is already small in size compared to its peers nationally, and somewhat under-equipped.

It is important to note that success in any one of the endeavors in research faculty recruitment and education suggested above will positively impact upon the others. For example, an increase in high visibility publications will likely increase faculty and student morale, as well as help attract new high quality students and faculty to the department, which in turn will increase the quality of the research, leading to better publications, etc., etc. While these goals are challenging enough, they could be made even more so by the proposed reunification of the two departments. The Molecular Biology faculty must therefore see reunification as a plus, for example resulting in reduced teaching loads, more graduate students and
better research space. It is clear that the challenges for Molecular Biology during the next decade are great, but so are the opportunities. The goal of emerging as a top department is attainable and the faculty should strive, and settle, for nothing less.