Outside Review of the Doctoral Program of the Department of Chemistry and Biochemistry of Texas Technical University (TTU)

February 2-3, 2009

submitted on February 23, 2009 to:
Prof. Clifford Fedler,
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Background
The review committee was charged to assess the strengths and weaknesses of the doctoral program in the Department of Chemistry and Biochemistry of Texas Tech University and to make suggestions for its future directions by the Dean of the Graduate School at Texas Tech University. The whole committee met over two days on February 2 and 3, 2009 with the internal and external reviewers present and again on February 6 among internal reviewers. The review team includes:

Dr. Michael Farmer (Chair), Department of Agricultural and Applied Economics & Range, Wildlife and Fisheries Management, Texas Tech University

Dr. Calvin G. Barnes, Department Chair. Department of Geosciences, Texas Tech University

Dr. Darryl James, Department of Mechanical Engineering, Texas Tech University

Dr. Max Diem, External Member, Visiting Committee, Department of Chemistry and Chemical Biology, Northeastern University, Boston, MA 02115

This document reflects the consensus views and impressions of the internal review committee. A separate document prepared by the external member, Dr. Max Diem, has been submitted under separate cover.

Throughout this report, the individual review criteria are rated on a scale excellent / very good / good / satisfactory / unsatisfactory. The review is based on

• an extensive self-evaluation: “Graduate Program Review of the Department of Chemistry and Biochemistry” (Professor Dominick Casadonte, Chair) which was distributed in advance to the members of the review committee
• meetings of the committee with the Chair of the Department  
• a meeting with the graduate faculty  
• a meeting with graduate students  
• faculty and graduate student questionnaires distributed with the self-evaluation  
• a tour of departmental facilities

**Overall quality and direction of program**

**Rating: very good**

The faculty in this department range from good to excellent and maintain a strong commitment to both research and teaching. Faculty members quite broadly seek to improve and to grow the department; and the review committee observed no desire to remain static. There is also a decision-making process in place to support this goal. The faculty show significant flexibility as they seek out and experiment with departmental decision and administrative structures to achieve this overall mission. The establishment of a new faculty merit and review committee, though too early to evaluate, is an indication of this on-going innovation.

The current Chairman is well respected among the faculty, and has developed a clear vision and mission for the department. The Department has made progress in the last five years to build strengths in computational/theoretical chemistry, nanomaterials and bio-organic / organic chemistry.

The department supports five discipline-based divisions that vary in strength. Traditionally, faculty replacements are within the same division, as necessitated by the need to cover undergraduate teaching requirements in each division. However, this approach leads to inflexibility when the Department may wish to respond to changing student numbers, research interests, and funding possibilities, especially at the graduate level.

As for new initiatives that may be profitable to pursue, we note the considerable gains, (and new equipment) in X-ray diffraction, NMR and high performance computing laboratories in the last five years. Although the department already obtains significant external research funding, the funding level could be increased by pursuit of newer funding sources such as NIH. Growth in the relatively new field of medicinal chemistry is a strategic initiative in the department and should also provide new avenues of external support.

One laudable aspect of the graduate program and its direction, strength and success is the close integration of the graduate programs with the multiple missions of the department. The complementary strategies are also evident in the undergraduate mission objectives to increase the number and quality of majors; the effect of which is to provide experience and resources for additional graduate students.

In recent years, the department has, in part, focused start-up funding toward modernization and to an upgrading of research equipment and laboratories because it is the availability of and access to these facilities that attract more competitive graduate students. We believe that completion of the
high-performance computer lab will continue this process. Moreover, the laudable success of the program to secure competitive STEM grants is a visionary long-term plan to add diversity and to promote community service. The long-term effect will be provision of pathways to graduate programs for under-represented students, with the additional effect of adding new resources for existing graduate students.

By broadening the scope of undergraduate and graduate research, teaching, and outreach, the department has reduced its vulnerability to short-term loss of student enrollment, etc. While this is a very strong positive for the department, there is presently a large strain on graduate students and faculty to meet the dramatic increase in undergraduate enrollment without commensurate increases in teaching staff, especially teaching assistants. Lags between success in undergraduate enrolment and acquisition of new teaching assistants to service those students threaten the benefits of integrating complementary activities across departmental obligations that can benefit the graduate program.

Faculty quality in relationship to students and graduate student quality

• Rating: Very good

In general the size of the graduate program relative to faculty size appears consistent with similarly placed peer-institutions. Faculty productivity in teaching and in creative work and research is judged to be very good, which is especially notable in light of increased undergraduate enrollment.

The Chemistry faculty generates more than $3M from external sources and has done so consistently over a prolonged period. Most faculty members are research active and the department has a strong teaching component at the undergraduate and graduate levels, leveraged by educational programs funded by external grants. Students rated faculty quality and mentoring as good to very good.

One concern raised is over faculty numbers. The 35 faculty number target was expressed often in separate conversations and is reflected in the long term goals of the strategic plan. In the opinion of the committee, that certainly would improve the department’s ability to service the graduate program if additions were of equal quality to the existing faculty. In the meantime, what would benefit the graduate program as it stands is the removal of a few key obstacles to leverage existing resources to benefit the graduate program.

One especially noteworthy feature of graduate recruitment by the department is the sponsorship of campus visits for selected student prospects. For this to be more successful, however, other impediments to expand graduate student numbers and graduate student quality must be removed. First, stipends are not competitive compared to other in-state competing institutions (TTU, A&M); second they are made on a 9-month instead of a 12 month basis; and undergraduate lab instruction by a graduate student teaching assistant, at the moment, appears to be growing.
The department compensates by providing student support from other sources, but it comes at the expense of graduate student enrollment. The highest quality graduate prospects receive ambiguous funding offers: summer support is budget-dependent; initial stipends are lower than from competing schools; and the added burdens of handling undergraduate lab instruction may mean increased teaching responsibilities, including evening and Saturday labs, which in combination can be a compelling deterrent to accepting a TA offer. It is incumbent on the University to work to reduce these uncertainties that create obstacles to increase enrollment and to attract the most promising prospects. Given the value of Ph.D.-level students in formula funding, it may be relatively costless, if not revenue-enhancing, adjustment.

Curriculum and Policies in support of graduate students

- **Rating: very good**

Based on graduate student comments and responses in the questionnaire, it appears that the majority of the PhD students are quite satisfied with the graduate program in chemistry and biochemistry. However, based on those same comments and responses, we would encourage efforts to streamline the process of admission to candidacy in the doctoral program. As noted by the outside reviewer, “the national average for admission to candidacy … [defined as] … passing of all qualifiers for the degree of PhD is more like 2 years, with many programs trying to reduce this even further.” In contrast, many students in the Chemistry/Biochemistry program take 3-4 years to reach candidacy.

This problem arises in part from the desire to assure that Ph.D. candidates have a broadly-based education. This is both admirable and difficult to achieve. Because advancement to candidacy is in part determined by students passing exams in a certain number of sub-areas, we suggest that the department pursue strategies to streamline the exam process and better facilitate student remediation. For example, students who are judged to be deficient in a sub-area may be required to take upper division undergraduate courses in lieu of waiting for the graduate course cycle, which may be every two years in certain sub-disciplines with limited enrollments. Sub-areas in which courses may only be offered biennially should consider whether subject overlaps with other programs (e.g., Physics, Biology) to provide students with alternative coursework.

In summary, we think that the department should pursue any path that can maintain the overall quality of graduate student preparation and additionally shorten the average length of time needed to achieve candidacy.

Adequacy of staff support, physical facilities, library resources, equipment, research facilities and program budget

- **Rating: good to very good**

There was modest discussion about this rating. On the one hand, the department maintains a machine shop, an electronic support staff, a scientific glassblowing shop (which is unusual), and a
The presence of these facilities is important for the continued success of the department. Moreover, along with the new X-ray diffraction, high performance computing and NMR laboratories, these facilities are selling points for student recruitment, valuable to other research and graduate programs at TTU.

The number and quality of staff seems very good compared to peer institutions. Although some faculty expressed concern about some of the technical staff, there is consensus that, in general, staff members meet or exceed expectations. Some graduate students noted that non-professional staff members were at times very helpful in directing graduate students as they navigated through their degree programs (noted above).

We have two concerns: Access to labs in other departments that can enhance graduate student research in Chemistry and Biochemistry; and a more secure system in place to maintain facilities. A key concern for graduate students is access to facilities, particularly ones outside the department, and limitations to expanding University facilities to keep pace with research success. So while physical and research facilities in the department have clear points of excellence, there will be a continuing need to provide areas of growth and strategic interest, such as medical chemistry, with facilities equivalent to those that already exist. This includes ready access to labs in other departments which may enhance student research.

As is the case across campus, the costs of maintaining research facilities, including shops, is typically borne by the home department. Some of these costs are offset by modest user fees; however, the individual department bears the sole financial responsibility for major repair and replacement costs. In the example of x-ray diffraction or high performance computing, which provide collective university-wide research benefits; such costs can cripple or destroy the utility of a lab if the department cannot afford to pay them.

It is our opinion that Texas Tech should devise strategies and policies regarding maintenance and operation of multi-user laboratories that provide services to users on a campus-wide basis. Departments such as Chemistry and Biochemistry, which generate significant F&A return, should be provided such support, a strategy that would benefit not just the home department, but any research group that can utilize the facility. These benefits include greater inter-departmental collaboration, a larger number of research proposals submitted (including multidisciplinary proposals), higher visibility of the research and graduate programs, and better success in recruiting the best graduate students.

**Suggested Changes**

We think the past and current efforts of the department is positioned them to continue improving as a department and to rise in the national rankings; therefore, our suggestions reflect possible obstacles and characteristics of the program we think would coincide with that outcome. Few suggestions are original with the review team; many were expressed by at least some faculty and staff. In general the faculty seems to agree that in order to become one of the top 50 graduate programs in the U.S., a set of milestones and measurable goals need to be established so the department can gauge its progress. Below are some suggestions.
1. Guarantee assistantships for 12 months. The department currently finds non-State sources to accommodate 12-month stipends, but these solutions are inexact and insecure. Texas Tech should commit to providing 12-month stipends for all supported graduate students.

2. Evaluate mechanisms to better ‘streamline’ the path to PhD candidacy so that most students reach candidacy at the end of their second year or beginning of their third.

3. Outline a sustainable plan with the College and University to repair or replace aging laboratory equipment, both for undergraduate labs and graduate research.

4. Increase the number of teaching assistantships to account for increasing number of undergraduate laboratories. This requires quick response from the University when additional TA support is requested; otherwise the lag time places strains on teaching assistants and the graduate program in general.

5. Increase F&A return (or reduce the department’s contribution to new faculty set-up) to permit purchasing of service contracts for instruments and facilities. Alternatively, devise a campus-wide policy for support of research-grade, multi-user labs.

6. Continue to work with other departments, the College and the University to maintain multi-user laboratories.

7. Increase faculty lines in both strategic and underserved areas while admitting more flexibility in faculty replacement.

8. Continue to target applications from under-represented minorities into the graduate program by advertising the graduate program specifically at south/central minority institutions. The STEM programs should produce some results soon in this direction.

9. Continue several initiatives that improve transparency, faculty engagement and faculty democracy including;
   a. Faculty Merit Evaluation Committee;
   b. Consider Publishing an Annual Research Report;
   c. Continue to broaden external funding sources (e.g. NIH);
   d. Maintain and buttress faculty Mentoring, such as proposal review.

10. Increase the number of ‘sweetener’ scholarships, to help recruit outstanding graduate student prospects.

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Michael C. Farmer  Calvin G. Barnes  Darryl James