

1999
University of Washington
Chemistry Department Review

1. The Review Process

All members of the Review Committee were provided with an extensive and highly informative self study document prepared by the department chair, Paul Hopkins, with help from faculty and staff. The four internal members of the Review Committee met with Marsha Landolt, Dean of the Graduate School and other members of the UW administration on June 8, 1999, to discuss the issues to be addressed in the review as well as the procedures and time line for it. During late September and October 1999, the internal members of the Committee held a series of meetings with departmental faculty, students and staff to elicit their opinions concerning the current status of the department and its plans for the future, as elaborated in the self-study document. The site review, in which all the three external members took part, was conducted November 8 and 9. The agenda is attached as Appendix 3. This report describes the Committee's findings and recommendations. Supplementary comments about undergraduate education and staff morale are attached as Appendices 1 and 2.

2. Background

The most recent review, conducted in 1987, pictured the Chemistry Department as emerging from a twenty-year decline. Between 1977 and 1987, thirteen new faculty members, most at the assistant professor level, had been recruited to fill vacancies. Annual grant income had quadrupled and a major investment had been made in instrumentation. The Center for Process Analytical Chemistry (CPAC) was just being established, funding had been obtained to build a new DNA synthesis facility, and an undergraduate major in Biochemistry was in the joint planning stage. Inadequate space, outdated laboratory facilities, and a meager operations budget hampered the Department. The review committee expressed concerns about uneven and in some cases inadequate teaching, overworked teaching assistants, an inequitable distribution of faculty workloads, and a lack of faculty leadership in the affairs of the department apart from the chair.

The 1999 self-study documents numerous developments that have enhanced the status and improved the productivity of the Department since the 1987 review. The vigorous campaign of faculty recruitment at the junior level has continued. These new faculty largely replace faculty who retired, moved to administrative positions, or left UW. Thus, the number of faculty lines allocated to the department has remained nearly constant. In contrast, the numbers of undergraduate students enrolled in Chemistry courses has expanded rapidly in response to the growth of biochemistry and other medically related fields: the combined number of Chemistry and Biochemistry majors has more than doubled. Faculty workloads have become more equitably distributed and the committee structure that looks after the day-to-day affairs of the department has been improved to encourage more participation.

For its part, the University Administration has provided for the construction of an impressive new wing of the Chemistry Building and for substantial renovations of laboratories and classrooms

within Bagley Hall. Three Senior Lecturers have been hired and additional state funded Teaching Assistantship and support staff positions have been assigned to the Department.

Since the last review, the department has formulated an established a development effort which has led to key endowment support for its activities.

3. Current Status of the Department

The Committee found the department to be an interesting and lively place characterized by high caliber leadership and enthusiastic faculty who are dedicated to teaching and scholarship. In the free market competition for a relatively limited pool of candidates, the external members were impressed that the U of W has succeeded in attracting a great cadre of young and mid-career academicians, placing it in a strong position with respect to other institutions of higher current rankings. The high caliber of their recruits is evident in their successful competition for research funding and awards (Sloan, Dreyfus, NSF Presidential Young Investigator, Pew).

The graduate program is basically sound:

- On average, 35 well-qualified graduate students enters the program each year, about 2/3 of whom successfully complete the requirements for a Ph.D.
- The median residence time is 5 years for Ph.D. graduates, a commendable record relative to other arts and sciences departments at the UW. This record is particularly striking when one takes into account the average number of quarters in which the typical chemistry student serves as a TA. Transfer and dropout rates have been very low in recent years.
- The level of student satisfaction expressed on the Graduate School's exit survey and by the students interviewed by the committee. The students are generally satisfied with the quality of the instruction and mentorship they are receiving, with the graduate curriculum and with the set of examinations used to monitor their progress.
- The competitiveness of the graduates for awards, industry jobs, and academic teaching positions following graduate school.

The Department's undergraduate teaching effort has grown substantially since the time of the last review, and the quality of the instruction has improved. In its visits to 100- and 200-level classes, the Committee found the instructors well prepared, articulate, and interested in the success of their students. The Chemistry Study Area is extremely successful in helping students master introductory material. The chemistry education staff are incredibly dedicated and provide a valuable, if often under-appreciated, service to the department. The chemistry curriculum as it exists today is one of the cornerstones of education at the UW at both the undergraduate and graduate levels. In particular, the chemistry department's courses are required for degrees in chemistry and biochemistry, as well as atmospheric sciences, biology, botany, geology, microbiology, psychology, zoology, aeronautics, chemical engineering, civil engineering, computer science, electrical engineering, industrial engineering, materials engineering, mechanical engineering, and forest resources. Math is probably the only other discipline with such a wide-ranging impact on undergraduate education at the University of Washington.

Although it constitutes only a small part of its total effort, the department should also take pride in its exemplary contributions to chemistry education and University outreach to K-12 schools, as

detailed in the self-study. The members of the committee felt that these programs could serve as models for the University's stated goals of increasing community outreach.

The Department has been remarkably successful in recruiting promising new faculty, in undertaking promising new research initiatives, in bringing new technology and new pedagogy into the classroom, and in expanding the university's outreach to the K-12 schools. Taking all these achievements into consideration, the Committee believes that the department is delivering excellent value in proportion to the University's investment in it.

Like any organization that is undergoing rapid change and is striving to achieve ambitious goals, the Chemistry Department is subject to stresses that lead to real and/or perceived problems:

- Many faculty members (tenured, non-tenured, and lecturers) expressed their sense of having taken on increasing responsibilities, above and beyond the norms that their profession demands or expects. This extra work has now become part of their regular workload, with no relief in sight.
- Graduate students are concerned about the department's lack of cohesiveness and sense of community. Many students feel a stronger sense of identity with their research areas (physical, inorganic, organic, analytical) than with the department as a whole. Indeed, everything from the types of graduate exams to seminars is segregated into the chemistry subdisciplines. When students attend a seminar that is out of their area, it appears to be a source of amazement. To a certain extent this problem is endemic to the field of chemistry, largely a consequence of its explosive growth. However, it also reflects the long-standing culture in a number of university departments, in which research subdisciplines have tended to remain insular even though the individual groups may share common interests and have good working relationships with one another. For students pursuing graduate degrees in environmental chemistry this problem is exacerbated by their sense that the department has discouraged them from pursuing their intended course of study and that they have been treated like 'second class citizens' with respect to teaching assistantship assignments.

4. Opportunities for the future

The Committee shares the Department's optimistic vision of the future, in which its national ranking continues to improve, and its teaching, research and service become even more central to the UW's mission. It also concurs with the department's vision of its evolution and future development, which is framed in terms of broad thrusts in chemical biology and materials chemistry (the highest priorities) as well as in environmental chemistry (assigned a somewhat lower priority).

Quoting Professor Crim's letter, "Almost any chemist will name biological chemistry, materials chemistry, and environmental chemistry as areas with special opportunities right now. The opportunities arise from a combination of new developments in related fields, new technology, and new awareness on the part of the scientific and technical community. The latter often translates into funding that drives basic research in particular areas.... The opportunity at the University of Washington comes from the strength of programs in areas related to chemical biology, materials chemistry, and environmental chemistry. The medical school, with its biochemistry program, is at hand for collaborations in chemical biology, and there are strong programs in materials engineering and in environmental sciences on campus. The Department recognizes the opportunities and has already begun to capitalize on them in both research and undergraduate instruction. (In fact, the enormous positive response of the students to new offerings in biochemistry is both a measure of

the need for chemistry to have a presence in these areas and a difficulty in the additional work it creates.) The materials, chemical biology, and theory parts of the Department stand out as particularly strong and vigorous, with a good cohort of individuals participating in each. The coordination of the environmental connection does not seem to be as good presently, but essentially everyone recognizes the need and opportunity. Careful attention should lead to good results.”

Professor Murray’ notes that “The research themes targeted for future development are while rather obvious, well chosen and timely. Within these themes lies the vision, of developing a Department in a way aimed at seeking intellectual prominence. The biological chemistry theme is especially obvious; there is a wide frontier of new science there, the NIH has vast resources to compete for, and there is a range of related activities on your campus--the Medical School being a particular case--that will themselves never be great without commensurate intellectual strength in Chemistry. Some will not agree with this assertion of dependency; but I maintain that it is readily demonstrable if one looks at a broad sweep of research, and particularly at analytical chemistry.

“The theme of materials chemistry is especially timely... This area is spreading basic chemistry endeavors into topics that overall with physics, mathematics, computer science, engineering, and traditional materials science. It is a natural for an interdisciplinary flavor... The environmental chemistry area is one that sounds good, but is still in a time of definition of what it actually is and can do, i.e., what are the central problems that chemists can prosper in? ... Washington is clearly struggling with defining this theme, but I would strongly encourage it to continue. I would make the same admonition that I noted above for materials chemistry; don’t be seduced into becoming an applied environmental chemistry group if the Department values *its* national recognition as a Department of Chemistry. Basic science is what chemists do best and they should try to focus on where they perceive they can make an environment chemistry contribution through basic studies.”

Professor Sligar emphasizes the advantages of having world class medical institutions like the Fred Hutchinson Medical Center close by, as well as outstanding collateral UW departments. He also points to the “well-developed and committed entrepreneurial enterprise in the Seattle area [which] provides a natural avenue for faculty to extend their research discoveries to practical application.”

5. Achieving the Department’s Vision for the Future

In the self study document, the department identified a set of resource issues it considered critical for preserving its present vitality and achieving its vision of becoming one of the top ranked chemistry departments at ranked state universities. At the request of the Graduate School, the Committee has made an effort to prioritize the department’s funding needs and to suggest ways in which the department might be able to make more efficient use of the resources that it already has at its disposal. The issues that the committee considers to be both urgent and having broad implications are discussed in this section and the remaining issues are discussed in section 6.

5.1 Departmental staffing for Undergraduate Service Courses

As in all research universities, the Chemistry Department at the University of Washington faces the major challenge of teaching introductory chemistry to thousands of freshmen and sophomores, most of whom will go on to majors in other disciplines. This “service” teaching responsibility places a much heavier stress on faculty, staff, and teaching assistants than is typical in science departments. Nowhere is the responsibility greater and the stress more acute than in the staffing of the first year

classes CHEM 142/152/162, where many UW 1st year students the first serious challenge of their academic careers.

The faculty and lecturers who bear the responsibility for these courses feel overworked, and the students who take them suffer from the lack of individual attention. (Teaching assistants in CHEM 142 and 152 are responsible for 48 students: twice as many as in CHEM 162.) The Committee believes that the University and the department should make it a high priority to ensure that 1st-year students receive the help that they need to master the difficult technical content of these introductory courses and to develop good study skills.

To achieve this goal, the committee recommends three specific actions:

- (a) The department should be provided with increased staffing to reduce the TA workload in CHEM 142 and 152 to 24 students per TA in the laboratories/quiz sections, and to provide for a substantial increase in the number of TA office hours. For this purpose, the department would require between 10 and 20 additional TA lines.
- (b) The department should receive funding to hire a full time staff member to coordinate web-based learning in the 100 and 200-level service courses.
- (c) The department should adopt a team-teaching approach to improve the instructional efficiency of the 100 and 200 level courses. Coordination of lecture content, lecture notes, accessory material, grading policies, etc., among the various sections of the courses would create synergistic interactions among the instructors of individual sections, while minimizing duplication of effort. In addition, this coordination would benefit pedagogy and improve the student's perception of the "fairness" of the courses.

The Committee believes that these changes would significantly benefit the quality of undergraduate education at UW and would also serve to reduce the stress on the departmental faculty and staff who share the responsibility for these service courses.

5.2 *Faculty Salaries*

The other high priority resource issue that needs to be dealt with if the department is to retain the excellent faculty that it has managed to recruit in recent years is the competitiveness of faculty salaries. In the words of Professor Sligar, "This problem is by no means unique to UW, but remains a serious hurdle to overcome. All departments are forced to be competitive at the initial assistant professor hiring as well as in retentions for the most illustrious faculty. Salary compression at the mid levels, however, is often the most serious problem and not easily addressed with minimal annual state raise pools. Great progress can be made, however, by a bolus infusion of merit raise pools. The University of Illinois was able to greatly help this problem in the Department of Chemistry by a ten percent increase in the salary pool over a two year period. Simply stated, this is a less expensive option than having your faculty exploring other opportunities. If they are looking, they could very well find something they hadn't appreciated at another institution. Solving that problem is significantly more expensive."

5.3 *Promoting a stronger sense of departmental identity*

While the morale of chemistry faculty, students and staff have improved substantially since the time of the last review, the department still suffers from a lack of cohesiveness and departmental

identity. This limitation is evident at the intellectual level, with the nearly complete segregation of subdisciplines. In addition, it affects daily operations, particularly interactions with departmental staff, many of whom expressed a feeling that they were not considered as contributing members of the department. With strong leadership in place, and a strong cadre of young faculty on board, this would be an opportune time to address this long standing issue. More specifically, to build stronger intellectual cohesion, the Committee recommends that:

- (i) the department develops mechanisms to maximize the shared learning experiences of graduate students, placing the specialized training that they receive in their respective subfields into a broader context.
- (ii) the departmental leadership work to instill a greater shared responsibility and teamwork in the teaching of the undergraduate service courses. For example, modifying course organization to elevate the roles of TAs to partners rather than adjuncts in student learning would be extremely valuable to both the undergraduates and to the TAs themselves. The talents, enthusiasm, and experiences of the chemistry education faculty would be valuable for helping make this vision a reality.

To build more cohesive interactions among faculty and staff, the department should strive to improve communication and discussion of departmental issues, goals, and achievements among all department members, including staff. The committee notes that the department leadership had already initiated such conversations with the staff and urges them to continue to promote positive interactions among faculty and staff.

5.4 *Fostering environmental chemistry*

The Committee concurs with the department's intention to focus its environmental effort on basic research problems with substantive chemistry content, recognizing that such a policy leaves open a wide range of choice. The Department is struggling with the issue of whether its environmental chemistry thrust will focus on chemical processes in the global environment or on the chemistry of 'environmentally friendly' materials and industrial processes. The lack of a clear departmental consensus on this issue tends to work against the recruitment of new faculty members with environmental interests when they are placed in direct competition with candidates with mainstream chemistry interests.

The Chemistry Department actively recruits students with interests in Environmental Chemistry and it succeeds in attracting more well qualified applicants than it is presently capable of advising and supporting as RA's, given the limited number of faculty with interests in this area. Some of the environmental chemistry recruits are persuaded to pursue more 'mainstream' chemistry research. Others are put in touch with faculty in other units such as the Chemical Oceanography group in the School of Oceanography who are able to advise them and provide them with RA support and office and lab space. In the assignment of TA's within the chemistry department, these students working outside the department have lower priority than 'mainstream' chemistry students. Hence, they are particularly vulnerable if their RA support should run out or if their adviser should leave the University. The Committee believes that these environmental chemistry recruits should not be discouraged from pursuing their intended field of study, and that they should receive be awarded the same privileges as other graduate students in the Department. If the Department decides that such a policy is not in its best interests, then its recruitment policies should be modified to more accurately reflect what it has (and does not have) to offer to students with environmental interests.

Regardless of how the Chemistry Department decides to define its own environmental effort, it is clear that the University of Washington, with its strong earth science departments is likely to be a major player in global environmental geochemistry. The Global Environmental Chemistry (GEC) Program has recently been established in the Graduate School, for the purpose of stimulating interdisciplinary cooperation in this emerging field of study. It is clearly in the interests of the GEC Program to for the Chemistry Department to recruit faculty members and graduate students with global environmental interests. Conversely, a vibrant interdisciplinary GEC program would benefit the Chemistry Department by enlarging the university-wide pool of faculty and TA's who could be called upon to teach Chemistry courses and mentor chemistry students.

6. Other issues

6.1 *Size of the Chemistry faculty*

The self study document (Section II-C.4) and presentations to the Committee by the Chair and many faculty members emphasized the relatively low faculty to student credit hour ratio compared to the average of similarly ranked departments in public Universities. The estimated deficit amounts to 2.5 in faculty positions, and it would probably be larger if the large enrollments in upper division undergraduate courses were taken into account. As a consequence of this deficit, faculty members teaching the upper division courses, including those in the Biochemistry major, are spending a disproportionate amount of their time trying to serve those students well. The deficit will worsen over the next 10 years unless the faculty count keeps pace with the anticipated growth in the number of students served by the department. Our committee believes that now that the infrastructure for serving students in the Chemistry and Biochemistry majors is in place, a small increase in the faculty count is in order. This increase should be strategically planned in conjunction with the Dean's Office to reduce class sizes in targeted courses without infringing too heavily on faculty time for scholarly work. In this planning, consideration should be given to the fact that the current faculty count is somewhat higher than the average count for the peer group (Section II-C.3).

6.2 *Size of the graduate program*

At present, 65% of graduate student support beyond their first year in residence is in the form of RA's, and the Chair indicated this that ratio would probably be higher, were it not for the department's needs for TA's to staff its service courses. Given the adequacy of grant and contract support, the size of the graduate program is in no way limited by the number of TA lines allotted to the department. (A similar situation prevails in many other science departments.) It follows that the ideal size of the Chemistry graduate program should not be viewed as a resource issue for the University, but as a departmental decision that is appropriately based on considerations such as grant and contract support and available space. In contrast, the number of TA-lines to be allotted to the department should be based solely upon instructional needs.

6.3 *Chemistry education and outreach*

The department's nationally recognized efforts in chemistry education and K-12 outreach may not be sustainable unless the University is able to find a more direct way of supporting them. The department receives no compensation, financial or otherwise, for these services to the outside

community; they have largely been sustained through the scholarly efforts of the senior lecturers. This academic year, in response to pressures from the College, the teaching loads of these senior lecturers have been increased, leaving them less time to devote to outreach. This situation creates the appearance, if not the fact, that these efforts are punished rather than rewarded.

Whereas the Office of Educational Partnerships provides visibility and advocacy for the University's centralized outreach efforts, excellent voluntary departmental efforts like the one in Chemistry have no office or dean to champion their cause. This issue might well be deserving of consideration in the University's current strategic planning exercise.

6.4 *TA salaries*

In order to compete for the most able graduate students the department is going to have to continue to supplement TA salaries. It is regrettable that the department feels that it has to use precious development funds for this purpose. Since it seems unlikely that the state legislature will raise TA salaries sufficiently to make them competitive, it might be worth exploring whether the shortfall could be reduced or eliminated by increasing research assistantship compensation to students engaged in full time research during the summer quarter.

6.5 *TA training and mentoring (see also Appendix 1)*

The Chemistry Department has a well-organized and comprehensive general TA training class that students take prior to entering the classroom. However, once TAs are in their classes, little support or feedback is available from faculty. A number of the students would like to see more teacher training and feedback on their performance as TA's. The committee believes that both TA's and undergraduate students would benefit if the team-teaching approach described in section 5.1c were extended into the classroom itself, with TA's serving as partners rather than adjuncts in student learning. Ongoing support and feedback from faculty and other TAs as the quarter progresses could be excellent avenues for providing this feedback and for improving the quality of instruction in lab and quiz sections. Another way to address this concern and to improve the level of preparation of the TA's would be for the department to offer a course in chemistry education on an annual basis that would be available, not only to Chemistry students, but to students in other departments.

6.6 *Remodeling Teaching Labs*

The lab space available for some courses is adequate, but depressing - certainly not the kind of physical environment that would lead a freshman to feel that chemistry is a dynamic, modern subject, much less that they were attending a vibrant research university. Although these labs should be remodeled, in the short-term, cosmetic updates could make a significant difference in the teaching environment. For example, simply installing new bench tops and putting fresh paint on the casework and walls could greatly improve the laboratory environment.

7. Recommendations

- (1) The University administration should provide the resources for 10-20 TA lines to bring the staffing level in CHEM 142/152 up to that of the more advanced service courses and for a staff person to coordinate web-based instruction in the 100-200 level service courses.

- (2) The University administration should provide a salary adjustment for the Chemistry department faculty.
- (3) The Chemistry Department should develop and implement a set of policies designed to promote a greater sense of departmental identity among the graduate students (including those pursuing environmental chemistry) and stronger camaraderie between its faculty, students, and staff.
- (4) The Chemistry Department should consider employing a team teaching approach in its large undergraduate service courses for purposes of standardizing grading practices among the different sections, making more effective use of lecture notes and web based materials, more fully integrating lectures and laboratories.
- (5) The University administration, in consultation with the Chemistry Department, should develop a contingency plan for dealing with increased enrollment pressures for chemistry service courses that will maintain an appropriate. This plan should take into account
 - projections for increases in undergraduate student population during the next decade and other factors likely to impact service course enrollments.
 - strategic plans for faculty recruitment in chemistry and related departments.
 - opportunities afforded by of web-based learning and other new developments in chemistry education.
 - faculty teaching loads.
- (6) Chemistry faculty leadership, together with interested faculty in other departments should develop a written strategic plan for fostering the expansion of biological chemistry, materials chemistry and environmental chemistry on the UW campuses.
- (7) The University administration and the Chemistry department should reach a clear understanding as to whether environmental geochemistry should be developed as
 - a major thrust of the graduate program in the Chemistry department;
 - an interdisciplinary program with active participation of the Chemistry department in which graduate students have the option to earn a Ph.D. in Chemistry; or
 - an interdisciplinary earth sciences program.

The ability to pursue the first two options would be contingent upon a departmental commitment to give environmental chemistry high priority in faculty recruitment and to address the needs of its current students working in this area. These decisions should also be reflected in updated and accurate information to prospective graduate students concerning opportunities in environmental chemistry research. Students who pursue Chemistry PhDs in these areas should receive equal treatment with regard to departmental resources, opportunities, and responsibilities.

- (8) The Chemistry department should be encouraged to expand upon its highly successful development efforts and to devote these funds to providing some of the kinds of programmatic and facilities embellishments that are hallmarks of top ranked chemistry departments. Among the items that might be considered are supplements to the startup packages for new faculty.
- (9) The Chemistry Department should formulate clear descriptions of the job requirements and standards for chemistry education faculty and use these standards as a basis for merit raises. Of

- (8) The Chemistry department should be encouraged to expand upon its highly successful development efforts and to devote these funds to providing some of the kinds of programmatic and facilities embellishments that are hallmarks of top ranked chemistry departments. Among the items that might be considered are supplements to the startup packages for new faculty.
- (9) The Chemistry Department should formulate clear descriptions of the job requirements and standards for chemistry education faculty and use these standards as a basis for merit raises. Of particular importance is clarification of the role of these faculty in undergraduate teaching versus chemistry education and K-12 outreach.
- (10) The Chemistry department and the University Administration should continue with the systematic renovation of the laboratories in Bagley Hall. Cosmetic upgrades to teaching labs in most need of renovation should be implemented immediately.
- (11) In response to the department's desire to increase the number of graduate students per faculty member, the Graduate School should allow the department to increase its graduate student enrollment, contingent upon the availability of departmental research assistantship support and space. The number of teaching assistantship lines assigned to the department should be based, not on the department's need for the support of graduate students, but on the needs of its instructional programs.

For the Review Committee:



John M. Wallace, Committee Chair
Professor, JISAO

Appendix 1: Additional Information Concerning Undergraduate Education

The Committee has several observations that lead to suggestions designed to further improve the quality and cost effectiveness of the instruction in the undergraduate service courses. We list our observations first, followed by suggested solutions.

- Little coordination exists among the various sections offered in the same course, even those taught during the same quarter. This means that students taking the same course during the same quarter have quite different requirements, grading criteria, and, in some cases, different subject matter. For example, one instructor states he will be happy to give all A's if everyone in class earns that grade; another states that department policy limits the number of A grades. This lack of uniformity creates many problems that undermine student appreciation for the course and lead to the feeling that the system is somehow "unfair."
- The department recently merged the lab and lecture sections. Such a merger has the potential to greatly strengthen student learning, and the department should be commended for this reorganization. However, at present, the consequences of the merger thus far appear to be largely administrative. For example, the TAs who teach the labs do not typically attend the lectures, so they do not know what is being taught in that portion of the class. In addition, the linkage between lecture material and lab exercises is not always obvious and is sometimes nonexistent. This problem partly reflects current course organization: the labs are created/updated/run by senior lecturers with little apparent input or support from faculty responsible for delivering the lectures. In addition, faculty do not appear to routinely meet with the TAs to discuss their teaching duties in lab or the problems they may be encountering with them. The faculty-TA interaction focuses instead on the quiz section. In fact, TAs are taught how to do/teach a lab by another TA (lead TA) rather than anyone in the faculty. As a result, some TAs do not actually complete the lab themselves prior to trying to teach it to their class.
- In trying to balance loads for teaching assistants, the department assigns TAs to multiple courses during a single quarter. These partial assignments appear to create more problems than they solve, at least from the perspective of TA and instructional quality.
- The lab space available for some courses is adequate, but depressing - certainly not the kind of physical environment that would lead a freshman to feel that chemistry is a dynamic, modern subject, much less that they were attending a vibrant research university.
- The faculty take only sporadic advantage of technology in teaching, such as incorporation of Web-based resources in lecture or supplemental course material.

The Committee supports the department's contention, outlined in the self study, that a team-teaching approach will be essential for improving instructional quality in the 100 and 200 level classes. If done well, this approach will also ease the load for the instructors in these courses. For example, provided teaching assignments are made in a timely manner, all faculty/instructors/staff involved in teaching Chem 142, could meet in the spring or summer. During this meeting, they could establish a uniform grading policy for that year, as well as develop/adapt a set of lecture notes that all faculty could use as is or as the core material for their sections. The department could place

the lecture notes on a website, maintaining appropriate links to the huge number of wonderful tutorials available from other universities and text publishers. Better integration of labs into the lecture, and vice versa, could be formulated at this time as well. Such interactions could reduce the teaching "load" required for the large introductory classes, particularly in terms of preparation of lecture material, by sharing the preparation among all the faculty involved in teaching that particular course.

Extension of the team-teaching approach into the classroom itself would benefit the undergraduates, as well as the faculty giving the lectures and the graduate students teaching the labs. For example, modifications of course organization that elevate the roles of TAs to partners rather than adjuncts in student learning would be extremely valuable to both the undergraduates and the TAs themselves. Anything that the university can do to facilitate such planning and coordination would be rewarded with better instruction and student satisfaction for a huge proportion of our undergraduates. Such support might include footing the bill for a biennial 3-day retreat for each introductory class. Considering the large numbers of graduate students serving as TA's in chemistry courses, there might even be sufficient student interest to warrant offering a graduate course in chemistry teaching.

Technology in teaching, including web-based instruction, offers many challenges, most of which the committee has encountered personally. However, these new technologies offer a myriad of opportunities. It is unlikely that these opportunities will be exploited without additional staffing to bring the necessary expertise and enthusiasm.

Partial teaching assignments invariably create additional work and stress for the teaching assistants. The department states that such partial assignments, which usually involve grading, are necessary because the graduate school frowns on having a TA assigned for just grading. If this policy is in place, we urge that the Graduate School reconsider. No one would wish to give an advanced degree to a student who has not actually taught students. However, it would be reasonable if one teaching assignment out of the three required by chemistry was a "grading" TA who held office hours and graded exams.

Appendix 2: Staff Morale

In conversations with staff, the Committee noted that many felt overworked and underappreciated. The Committee felt that improved communication would improve morale and noted that the departmental leadership had already initiated such conversations. The department's efforts to promote positive interactions among faculty and staff should continue.

UNIVERSITY OF WASHINGTON
The Graduate School

Department of Chemistry Program Review
November 7, 8, and 9, 1999

Sunday, November 7

7:00 Review Committee Executive Session
Union Bay Café
3515 NE 45 Street
527-8364

Monday, November 8

Conference Room 102, Chemistry Building

8:30 Department Chair Paul Hopkins

9:30 Environmental Faculty
Professors Engel, Gammon, Mayer, and P. Reid, and Professor James Murray of
Oceanography

10:15 **Break**

10:30 Biological Faculty
Professors Beeson, Drobny, Gelb, Kovacs, B. Reid, Robinson, Schurr

11:15 Materials Faculty
Professors Campbell, Dalton, Kahr, Xia

12:00 **Working Lunch**
Faculty Club Music Room
Committee and Professors Borden, Goldberg, Ruzicka, Synovec, Turecek;
Lecturer Wiegand; graduate student Lisa Coyle

Conference Room 102, Chemistry Building

1:30 Graduate Program Overview
Professors Heinekey and Slutsky; Graduate Advisor Lynne Llywelyn

1:50 Meeting with Graduate Students

2:50 Lecturers' Perspective
Lecturers Nyasulu, Selfe, Wiegand

3:15 **Break**

3:30 Undergraduate Program Overview
Professors Gouterman, Heinekey, Hopkins; Undergraduate Advisors Lukaczer
and Stone

- 4:10 Continuation of Undergraduate Program Overview
Professors Callis, Campbell, Dalton, Kahr
- 4:40 Meeting with Undergraduate Students
- 6:30 Review Committee Executive Session
Ponti's Seafood Grill
3014 Third Avenue North
284-3000

Tuesday, November 9

- 8:30 Tour of Bagley Hall and new Chemistry Building
Led by Gary Pedersen, Director of Facilities

Conference Room 102, Chemistry Building

- 9:30 Theoretical Faculty
Professors Borden, Jonsson, Prezhdo, Reinhardt
- 10:15 **Break**
- 10:30 Science Education, Service Learning, Outreach
Lecturers Selfe and Wiegand; Professors Dalton, P. Reid, and Woodman
- 11:15 Review Committee Executive Session
- 12:00 Review Committee Lunch
Faculty Club, West end of Dining Room
- 1:30 Paul Hopkins and others by request
- 2:30 Review Committee Executive Session
- 3:00 **Exit Interview I**
Paul Hopkins and selected members of the Department
Deans Landolt, Slattery, Hodge, Christian, Campbell; Associate Provost Debra Friedman; Beatrice Greenwald, Assistant to Dean Slattery; Augustine McCaffery, Assistant to Dean Slattery
- 4:00 **Exit Interview II**
Review Committee meets with Deans and Associate Provost without members of the Department present
- 5:00 Site visit ends

March 11, 2000

Dear Dean Landolt:

It was a pleasure to participate in the review of the Department of Chemistry at the University of Washington. The Department is an interesting and lively place that is benefiting from high calibre leadership and enthusiastic and dedicated faculty. They have positioned themselves very well to capitalize on broadly recognized intellectual opportunities in chemistry that link it to other important areas. The special aspect of the situation at the University of Washington is the prominent place occupied by the other areas to which Chemistry connects. Almost any chemist will name biological chemistry, materials chemistry, and environmental chemistry as areas with special opportunities right now. The opportunities arise from a combination of new developments in related fields, new technology, and new awareness on the part of the scientific and technical community. The latter often translates into funding that drives basic research in particular areas. The old (at least to chemists) saw that chemistry is the "central science" is in fact true. Its centrality connects it to many other programs and is the force that has made the discipline constantly renew itself over the years. A chemistry department today looks very different than it did 30 years ago. Most of us see our departments and our own research programs change beneath us during our careers, the hallmark of a vigorous and dynamic field.

The opportunity at the University of Washington comes from the strength of programs in areas related to chemical biology, materials chemistry, and environmental chemistry. The medical school, with its biochemistry program, is at hand for collaborations in chemical biology, and there are strong programs in materials engineering and in environmental sciences on campus. The Department recognizes the opportunities and has already begun to capitalize on them in both research and undergraduate instruction. (In fact, the enormous positive response of the students to new offerings in biochemistry is both a measure of the need for chemistry to have a presence in these areas and a difficulty in the additional work it creates.) The materials, chemical biology, and theory parts of the Department stand out as particularly strong and vigorous, with a good cohort of individuals participating in each. The coordination of the environmental connection does not seem to be as good presently, but essentially everyone recognizes the need and opportunity. Careful attention should lead to good results.

The excellent connections available to the Department and its will to exploit those connections seem to put it in a strong position for the future. Thus, one must ask if anything stands in the way of the University using the strength of the Department of help drive excellence in other units. The goal is not solely to increase the impact of Chemistry by achieving a higher level of perceived quality, by attracting more and better graduate students, and by capturing more research funding. The goal also includes helping other parts of the University with better connections to a strong Department of Chemistry.

The Department points to many impressive accomplishments. The faculty are enthusiastic and dedicated to both their teaching and scholarship, and many of the young people are flourishing. The Department is delivering excellent value to the University and has good plans for the future. However, the situation is fragile, as many individuals are carrying loads that they cannot possibly sustain while moving their scholarship in new directions. The willingness of people to take on very heavy teaching responsibilities has produced the success in the undergraduate program, but it is sustained by heroism. The Department and University must find a way to make the program work in the long term. Only with such a plan in place will the Department make the connections that benefit the entire campus and move its program forward. Without it, the Department will lose

ground rapidly on all fronts. Today a strong Department and University must run very hard to stay in the same place. Moving ahead requires special attention.

If forced to suggest a single action that the University could take to propel the Department and those programs connected to it forward, I would select relieving the heavy undergraduate instructional work load that the faculty bear. It is important to note that the faculty are not teaching too many courses. The classroom assignments are nominally competitive with peer departments. Rather, many of the courses require enormous effort because of the large number of students and small amount of teaching assistant and staff support. An infusion of resources into staff and teaching assistant positions, ideally as flexible money for the two areas, can pay large dividends along the lines described above: the faculty can make and exploit the connections that advance the University and the Department. The careful documentation from the Department made the factual case for help in the area of support staff and teaching assistants, but first-hand observation made the psychological case for me. These dedicated and hard working people are spread too thin, and trouble lies ahead.

I do not intend to slight other important areas in these comments. Curing salary inequities and improving the outmoded instructional facilities are real and immediate needs. The call for help in those areas goes beyond the usual argument that more resources improve a Department, but the need for staff and teaching assistant support is so acute as to overshadow even the other important needs. (It also seems likely that the University can make progress on those fronts with a concerted, but less urgent, effort over the next few years.) The boost in morale that will come from increased salaries is very important and has a stabilizing effect. It makes talented individuals less likely to seek and entertain outside offers.

The University has a cooperative and eager collection of faculty in Chemistry. Action by the University that will not break the bank can make a real and measurable difference. I am confident that the Department will welcome careful examination of the use to which it puts increased resources. The accomplishments and potential of the Department merit strong and tangible encouragement from the University. The investment promises to pay dividends well beyond the Department of Chemistry.

Sincerely,

[VIA E-MAIL]

F. Fleming Crim
John E. Willard Professor
Department of Chemistry
University of Wisconsin - Madison

November 24, 1999

Professor John M. Wallace
JISAO, Box 354235
Univ. of Washington
Seattle, WA 98195

Dear Mike:

There follow my numbered draft comments on the Department of Chemistry Review. I have not organized it into a "story" since I know that you will divide it into a master outline. If you want me to amplify on anything that seems unclear, please let me know.

It was great to get to know you! And thanks for your superb hosting.

1.. The self-study document was very useful to this external reviewer. It dissected quantitative aspects of the Department's instructional load, its faculty, and resources, relative to a set of peer institutions for which comparable data had been obtained. The quantitative evidence presented compelling evidence that there are resource problems in faculty salary, TA stipend support, and staff.

2.. My assessment of the Department, before the actual review trip, included the following:

a).. The analytical chemistry group is first rate. I would have ranked it higher than the national polling data, but that was before I became aware of the loss of Bruce Kowalski. I am glad to hear that a senior replacement search is planned; you simply cannot ignore the diminution of one of the Department's most distinguished sub-disciplines without cost to all. Even without Kowalski, the analytical group is very potent. I include work by Campbell as part of the analytical program.

b).. Materials chemistry at Washington has the nucleus of a world class program, and a great foundation on which to build, as planned. I would add from my own experience that growing a fine materials chemistry program in a fundamental-minded chemistry Department requires continued attention to a faculty orientation to a good balance of basic with applications materials research.

c).. The new space that I saw during a visit last December is a very important addition to the Department's facilities.

d).. The Department is doing an exemplary job in its instructional program for undergraduates, and somewhat knocking itself out in the process.

e).. The faculty grant acquisitions continue to increase, but it was not clear to me that the new resources are as well spread among the active faculty as one would want.

3. The research themes targeted for future development are while rather obvious, well chosen and timely. Within these themes lies the vision, of developing a Department in a way aimed at seeking intellectual prominence.

a) The biological chemistry theme is especially obvious; there is a wide frontier of new science there, the NIH has vast resources to compete for, and there is a range of related activities on your campus--the Medical School being a particular case--that will themselves never be great without commensurate intellectual strength in Chemistry. Some will not agree with this assertion of dependency; I maintain that it is readily demonstrable if one looks at a broad sweep of research, and particularly at analytical chemistry.

b) The theme of materials chemistry is especially timely. There are huge numbers of intellectual challenges. (I know parts of this area personally rather well.) This area is spreading basic chemistry endeavors into topics that overall with physics, mathematics, computer science, engineering, and traditional materials science. It is a natural for an interdisciplinary flavor. The research support base is pretty good, but not the same as the biological area.

c) The environmental chemistry area is one that sounds good, but is still in a time of definition of what is actually is and can do, i.e., what are the central problems that chemists can prosper in? The support base is also rather vague. Washington is clearly struggling with defining this theme, but I would strongly encourage it to continue. I would make the same admonition that I noted above for materials chemistry; don't be seduced into becoming an applied environmental chemistry group if the Department values national recognition as a Department of Chemistry. Basic science is what chemists do best and they should try to focus on where they perceive they can make an environment chemistry contribution through basic studies.

d).. I would comment that it is too easy to imagine that a Department's interactions with other units on campus are measured solely in research collaborations. The other facts of life include informal cross-department consultations among faculty and students, access to instrumental facilities, access to courses on advanced topics, and to lectures and visiting speakers. This kind of intercourse was not discussed during the review, so I want to point it out here.

4.. What are the principal barriers to progress of this Chemistry Department?

a).. The faculty workload is miserably high. To expect any kind of improvement in excellence to emerge without attention to the drain in time away from scholarly research and training of graduate students is folly in my view. The University administration apparently has been willing to ignore the increase in enrollment pressure in the Department, to the Department's detriment. At the same time, some of the classroom pressure originates from the Department's attitude of exceptional service, to client Departments and programs, and to students. The result is a myriad of course tracks (three different kinds of introductory organic chemistry!). The Department should give some attention to its self-preservation. So should the administration.

b).. The recruiting of quality graduate students in chemistry is a national problem, but not an impossible one. Lots of very fine Departments succeed. However, a competitive stipend is absolutely necessary-- at least near the national average.

c).. The Department faculty salaries are described as lower than the peer averages. Obviously the review did not go into details as to people. However, my long-standing view on salaries is that priority simply has to be placed on protecting the Department from loss of its senior and mid-career stars, and on hiring at the entry level. The clearly will be salary compression in the middle-- I would put my relief dollars there on the superior teachers, who after all carry a most important role that must be respected.

d)... There is a lot of space in old Bagley Hall that is quite run-down. The general chemistry laboratories are a bit of a disgrace. And I am told that about 25% of Bagley is unrenovated research space--this is actually good news since the Department does have an avenue to solve research growth problems with remodeling expenditures, short of putting up new bricks and mortar.

5. My recommendations regarding new funding are placed on what I perceive will have the greatest impact. In order--

a).. The TA and staff request should be fully honored, and I would advocate that the request of ten TA slots is about half of what it should be. The staff request may also be low but I was unable to analyze this as fully. The TA funds need not all be expanded on expanding the graduate student population, but to the extent that the population can be expanded with quality students, then the research program of the faculty will prosper. Certain of the administrators at the exit interview apparently did not know that graduate students are not a "burden" to science

faculty, but rather an essential vehicle for carrying out experimental research. (I was appalled at this level of ignorance.)

b).. The faculty salary funds should be given serious attention. I would recommend the guidelines noted above, but in fact the Department Chair should have the freedom to exercise his proper judgment in this arena.

c).. I would place space renovation next on the priority list, for the general chemistry labs, and for research space expansion.

d).. The Department has requested several new faculty lines. I agree with these requests as reasonable.

Why do I make the above recommendations? I foresee that there is little chance that the Department will substantially improve in its present circumstances. If the University values having a Department in the poised to improve position that Chemistry is in, and values excellence, it should listen to its problem. Secondly, my recommendation targets items that will alleviate the crushing teaching load of the faculty without sacrificing teaching excellence- these include TA's and staff, and by concurrently increasing the ratio of graduate students to faculty, give the Department a larger core of researchers. It obviously will be a challenge for the faculty to raise long-term grant support for increased students, but that's a necessary challenge for any research university. Increased staff should target the management and development of undergraduate laboratory courses. Thirdly, the increased TA core should help reduce the workload for the TA's; it presently is far above what most universities require in chemistry departments.

Finally, I must voice my distress at hearing the Chemistry Department characterized as a "money-sink". This is not an attitude that a responsible administrator should have; were I the Provost it would be grounds for a personnel change. It is not the Department's fault that it has insufficient resource, but rather the administration's!

Best regards,

[VIA E-MAIL]

Royce W. Murray
Kenan Professor, Department of Chemistry
University of North Carolina, Chapel Hill

Seattle Chemistry Review Stephen Sligar

I. The Opportunity.

The University of Washington Department of Chemistry is ideally poised for an explosive advance in its level of contribution to the central emerging intellectual disciplines of chemistry. In examining the various ranking lists of chemistry departments in the United States, one is struck by the unique environmental advantages that UW possesses over many of the currently ranked top ten institutions. These specific areas of opportunity include:

1. The close partnership with a world-class medical school.

This reality fact is cited by some of UW's most outstanding Chemistry faculty as being an important source of collaborative research programs and cross training of graduate and post-doctoral associates.

2. The existence of multiple local established research institutes and programs.

Entities such as the Hutchinson Center provide excellent opportunities for close interactions and collaborations in areas of chemical biology and biomaterials science which are cornerstones of the Department's research focus for the next decade.

3. The existence of collateral outstanding departments at UW.

These provide a natural bridge for chemists to explore cutting edge research agendas in the areas of materials chemistry and biotechnology. Particularly strong departments and programs include the outstanding Bioengineering Program, which displays a firm commitment to biomaterials development, the Biotechnology initiative which has provided a rich infrastructure to advance discovery in the genomic and post-genomic/proteomic arenas and the Department of Physics which with its historical strengths has made significant commitments to future endeavors in the area of biological physics and theoretical chemistry..

4. A well-developed and committed entrepreneurial enterprise in the Seattle area.

This provides a natural avenue for faculty to extend their research discoveries to practical application. The current crop of outstanding young scientists seeking academic appointments in chemistry, particularly in the disciplines of chemical biology and materials science, increasingly demand that their home institution provide functioning infrastructures in intellectual property management and facilitation of faculty start-up companies.

5. A deep bench for private fund raising from individuals and local foundations.

Increasingly, academic institutions need critical revenue sources from the private sector to launch new initiatives and recruit/retain outstanding faculty and students through named fellowships and professorships.

II. Current Status.

A major metric of success for any department is the success of faculty hires. This is one area where there is a clear free market competition for a relatively limited pool of candidates. In this arena, UW has clearly excelled. This success gives the Department a great cadre of young and mid-career academicians which now, with the other unique strengths discussed, gives the Department an excellent position vis a vis other institutions of higher current rankings.

The Department has a deep bench to call on for leadership. The current administration has had dramatic success in key managerial and strategic decisions. Since the last review, it has formulated an established a development effort which has led to key endowment support for departmental activities. It is important that this resource pool be freed for use in strategic initiatives rather than simply meeting the needs for operations, e.g. undergraduate instructional delivery.

Enrollments are increasing, outstanding faculty are in place, and research funding has dramatically increased. A new research and instructional building has opened. There should be no obstacle placed in the path of the Department as it defines the core disciplines that success in medical science, bioengineering and environmental studies.

III. The Problem and Solution.

Two major issues are preventing the Department of Chemistry from realizing a quantum leap in national stature and fulfilling its role of providing the core discipline needed by the clinical and basic science departments of the medical school.

By far the most critical is an advance in time management of both faculty and graduate teaching assistants. Simply put, the time commitments demanded by the successful service component of the Departments instructional delivery have become seriously out of hand. While ultimately the addition of a few faculty lines would provide additional personnel to aid in instructional delivery, the severity of the problem should not be underestimated. Most peer institutions, and certainly those that UW would like to match or exceed in the various rankings enjoy a rich instructional infrastructure of support staff and facilities.

While the existing small staff has received important kudos for their role in instruction, they have all taken worthy initiatives in additional service areas such as outreach which, again due to the level of success, can only be competitive with service instruction for the limited number of hours per day.

It is also important to have a moderator in place for the free market of instructional delivery. In a very real sense, the Department finds itself in the current situation in large part because of its own success in meeting the needs and challenges of a diverse chemical education. Whereas each discipline in the undergraduate curricula could make a compelling case for an individually tailored course structure in the various areas of chemistry, no department can meet all calls for a diversity of similar courses all offered each quarter. When the department would launch a new version of its core curricula for a given group, the dedication of the faculty and students always generated an extremely popular variant as judged by enrollments. Without a mechanism in place for timely resource flow from the Central Administration to the successful departments, the Department will soon overtax the faculty, staff and graduate assistants that are responsible for this success.

The second area of need of the Department in order for it to realize a measurable advance in international stature for UW lies in the areas of salary compensation. This problem is by no means unique to UW, but remains a serious hurdle to overcome. All departments are forced to be competitive at the initial assistant professor hiring as well as in retentions for the most illustrious faculty. Salary compression at the mid levels, however, is often the most serious problem and not easily addressed with minimal annual state raise pools. Great progress can be made, however, by a bonus infusion of merit raise pools. The University of Illinois was able to greatly help this problem in the Department of Chemistry by a ten percent increase in the salary pool over a two

year period. Simply stated, this is a less expensive option than having your faculty exploring other opportunities. If they are looking, they could very well find something they hadn't appreciated at another institution. Solving that problem is significantly more expensive.

These are my two finely targeted recommendations for investment by the UW Central Administration to allow Chemistry to become a member of the top-ten rankings. Asking what dollars will buy the biggest remedy and growth opportunity for UW leads to the conclusion that relatively modest addition of teaching assistant lines and professional staff to aid in the mission of undergraduate service teaching will have a dramatic effect by freeing the faculty and graduate students to make the critical connections to the other units on the UW campus and Seattle area to realize collaborative research endeavors and successful joint ventures.

With any investment, one needs to have a method to assay for success. The suggestions provided herein will directly result in improved instructional scores, a greater degree of research productivity as measured by publications, citation indices, and successful competitive grant applications as well as in the success of the graduate program as measured by employment offers and exit surveys.

Through this plan, UW Chemistry will flourish.

[VIA E-MAIL]

Stephen G. Sligar
Janet and William Lycan Professor and University Scholar
The Beckman Institute
University of Illinois