REPORT OF THE REVIEW COMMITTEE FOR THE DEPARTMENTS OF ATMOSPHERIC SCIENCES, GEOLOGICAL SCIENCES, GEOPHYSICS PROGRAM, AND THE SCHOOL OF OCEANOGRAPHY

August 14, 1999

Committee Members

Stephen J. Burges, Civil and Environmental Engineering
Ernest M. Henley, Physics (Chair)
Christopher W. Stubbs, Astronomy and Physics
Gene L. Woodruff, Chemical Engineering

Robert P. Lin, Univ. of California at Berkeley
Nick McCave, Massachusetts Institute of Technology
Ronald L. Shreve, Univ. of Califonia at Los Angeles
Ronald B. Smith, Yale University

1 COMMITTEE CHARGE

The Committee was appointed on March 24, 1999 with a charge to assess the quality of the degree programs , to provide the faculty with constructive suggestions for strengthening their programs, and to suggest ways in which the University could optimize its instructional role and maximize its impact in the area of Geo-sciences.

2 COMMITTEE OPERATION

A first meeting of the local members of the Committee with the Deans of the various Colleges and the Graduate School took place on April 9. Subsequently, we met by ourselves to decide on strategy and to discuss information we might need. Thereafter, we had meetings with chairs, heads of connected institutes, Alvin Kwiram (Vice-Provost for Research), members of the faculty, and representative graduate and undergraduate students. These meetings took up almost seven mornings and/or afternoons. We tried to have discussions after each of these meetings. In addition, we set some time aside for further discussions of the local members of the Committee and to flesh out a series of questions for the external consultants of the review process. The Committee divided up in order to visit space occupied by all the units being reviewed. Finally, the entire Committee got together for an informal dinner on May 11, prior to a 3 day meeting on May 12-14. The schedule is attached as Appendix A and shows that we left some time each day for discussion during an executive session. At the end we asked Bernard Hallet, Director of the Quaternary Research Center to meet with us again in order to answer some questions. We also had the usual exit interviews.

The Committee did the best it could to respond to our charge. However, a review of 4 units in 3 days is overwhelming and we were unable to do as thorough a job as we would have liked. We apologize if we missed important points.

A preliminary "items for the report" was distributed to the Committee shortly after the end of our meeting, so that the external members could see the items that were likely to be in the report so as to help them draft their own letters to the administration. The actual report was not prepared until early July due to the absence of the chair in the interim.

3 QUALITY OF UNITS

3.1 Research:

All four units reviewed are generally strong ones. Both Atmospheric Sciences and Oceanography are superb. When you are at or near the top of your class you have to work hard to remain there, We believe that Oceanography is doing all the right things to do so.

Atmospheric Sciences will need to keep its observational abilities strong and should reach out more to related disciplines.

To become even better the Geophysics Program and Geological Sciences need to reach out to each other and foster further collaborative efforts. Geological Sciences is particularly strong in hard rock geology and in surface processes. The Department might consider a renewed program in planetary geology. Geophysics should lead an effort to expand the present seismic network with a far greater State input. (We believe that the State is derelict in its duty in this area and would be shown to be so by a moderate earthquake.)

It is important to have an orderly process for replacing retiring faculty members in all units, with bridging funds being made available, if necessary, to avoid having to hire many faculty members in a unit in a given year. This requires planning by the faculty of the units involved and may demand help from the administration. Such hiring should take into account Section 4 of this report. Geological Sciences needs to be able to begin now to replace the relatively large number of faculty members close to retirement with young vibrant ones. They should make a concerted effort to hire more women as regular faculty members. The fraction of women who are undergraduate majors and graduate students, alone, demands this effort. Atmospheric Sciences suffers somewhat from the same problem but may be on its way to correcting it.

3.2 Education:

The education being offered by all four units, by and large, is considered a good one by the students and appears to be thorough. Atmospheric Sciences needs to pay more attention to its undergraduates and should put outstanding teachers in the introductory sequence to attract more students. All the units should put more effort into TA training and (thereafter), if possible, give TA's as much opportunity as possible to teach students directly.

We believe that the units should make serious efforts towards a MS degree that takes 2 years and not 3 to 4 years. If the students get more guidance in choosing thesis topics and finding an advisor, we believe that this goal is attainable.

We recommend that units, individually or in collaboration, offer "Career Opportunity" seminars. These should be organized with students and can be given by visitors who live locally. The students should have informal access to speakers.

Undergraduate Education

Undergraduate involvement in research:

As the UW moves towards a broader participation of undergraduates in research, the earth sciences offer substantial opportunities for achieving this goal. In particular, the committee was very favorably impressed with the seagoing experiences offered to under-

graduates in the School of Oceanography. The integration of hands-on field experience with the curriculum can serve as a model for other efforts on campus. Another very successful example is the Space-grant project, initiated and administered by the Geophysics program faculty, which benefits students in a variety of disciplines and attracts high quality high school students to the UW. Other examples of hands-on learning include the field experience offered by the Department of Geological Sciences, and the summer internships that are common in Atmospheric Sciences.

Atmospheric Sciences

Undergraduates were pleased overall with their experiences in the Department of Atmospheric Sciences, and particularly with the computer lab. However, the education being offered can and should be improved. The Department is aware of some of the problems and is acting to correct them. The committee encourages the Department to carry through the revisions to the undergraduate curriculum that were described, allowing a variety of tracks to the degree without compromising the quality of the degree program. This step should also help make the program more attractive to a greater variety of students.

The self-study document expresses some concern regarding the number of undergraduate majors relative to the strength of the graduate and research programs of the Department. The committee was informed that demand from students in the ROTC program fluctuates widely, and this drives swings in the number of declared majors. There is also a somewhat limited job market for recipients of BS degrees in atmospheric sciences; the National Weather Service has a rigid set of required courses. While these are undoubtedly factors in determining the number of undergraduate majors, the committee found that the Department could take some steps that might increase interest in undergraduates contemplating a major in Atmospheric Sciences (see below). Indeed, this is the only degree program in the Northwest and should be the largest one in the western U.S.

We urge the Department to make the required effort to increase the number of its undergraduate majors and improve its undergraduate program. The undergraduates themselves have good ideas on how to improve the program. If consulted, they could be helpful to the Department. We heard some complaints about the uneven quality of the courses taught. The introductory courses can evidently spark interest in many of the students who become majors. By insuring that these classes are taught by engaging and effective instructors, the Department would maximize the level of undergraduate interest. Once students have declared a major in Atmospheric Sciences, it might help to have a brief tour of the building and facilities, and to welcome the new students into the life of the Department. The committee was happy to learn that the undergraduates had been provided with keys, to allow after hours access to the Departmental resources and facilities. This is a very positive step in incorporating the undergraduates into the fabric of the Department. Providing these same students with year-round access to a

communal area for studying is another step the Department should implement.

Geological Sciences

The Department of Geological Sciences has an impressive undergraduate program, and the current students are very enthusiastic about the revised undergraduate curriculum. Given the dismal state of Johnson Hall (which the students consider a definite "turn off") this is quite an achievement.

The faculty have made some concerted efforts to improve the program. All undergraduate labs are team taught in a meaningful way. A new undergraduate minor has been developed. The students feel that they have a good rapport with the faculty, but argue strongly that there should be more female teaching faculty. We agree and believe that this is particularly important since more than half the students are female, and, according to the faculty, the women are typically the best students.

The students see the field course as an important and effective capstone experience. They felt, however, that it would benefit from an infusion of modern technology, such as GPS, and from inclusion of study and measurements of surface processes and observations and logging in boreholes in addition to the traditional geological field mapping. This is an essential feaure of the undergraduate degree program that must be maintained.

The undergraduate advising process was viewed as very strong in the initial stages, but once students were passed from the undergraduate advisor to the care of individual faculty members the reviews were mixed. The Department might consider adding a nonacademic staff person (part-time or one person for both undergraduate and graduate advising.) There is an active Geology Club, and its success seems to derive from major contributions from both the faculty and the students.

Aside from the problems of Johnson Hall, which are difficult to overstate, (the building and facilities are abysmal), there are a few other problems. The TAs teaching the undergraduate courses are not always well trained. It is also troubling that, as we understand it, 75% of the student credit hours in the department are in three courses, all of which are taught by lecturers.

The committee suggests that the Department consider one or more required courses in Geophysics as an ingredient of the major. Such courses would need to be discussed with Geophysics and might have to be developed, if they are not presently available. These courses could be jointly listed and even team-taught.

The students expressed a desire for more contact with non-academic career options, through seminars from local geoscience experts.

Geophysics

The Geophysics Program does not offer an undergraduate degree. It has recently developed an undergraduate minor, but only one student is currently enrolled. Several of

the faculty express enthusiasm for undergraduate teaching, and some good new undergraduate courses have recently been introduced; examples are Geophys. 201 and 202. In addition, there are many 400 level courses available, many of which are cross-listed with Geological Sciences.

The Space Grant Program is administered by Geophysics, and this has been a great success by any standard. This program contributes in a significant way to undergraduate education across the campus generally, and, in particular, some undergraduate physics majors are performing research projects with Geophysics faculty.

The committee considers it likely that the Geophysics faculty could play a very important role in a 5-year Masters program in Earth Sciences (see Section 4) . In addition, it seems appropriate that Geology undergraduates should be required to take one or more Geophysics classes as part of their program. The appropriate courses should be worked out between the two units.

Oceanography

The School of Oceanography has an extraordinarily impressive undergraduate program and undergraduate students. This is particularly striking given the relatively low level of state support for the faculty, the School's policy of admitting essentially every student who applies, and that this is the only major research university to offer an undergraduate education in oceanography.

Undergraduate enrollment has remained stable at about 100 students for about the last 20 years. The percentage of female students has risen steadily in recent years, and women are now a majority.

The major strengths of the program are the well structured curriculum, the enthusiasm of the faculty, the outstanding opportunities for undergraduate research, and a very effective (although also very demanding) capstone (1-12 credit) course which all students must take, namely Ocean499, undergraduate research.

The program benefits enormously from the 45 days of ship time provided by the University for student research, a feature that should certainly be preserved.

The students are very enthusiastic about their program. They consider the courses well taught, the faculty both highly competent and very open to interaction, and the research program both a great experience and a pleasure.

3.2.1 Graduate study

Atmospheric Sciences

The graduate program in atmospheric sciences is seen by the students as a high quality experience. The research programs are well supported; this benefits the students directly. The graduate coursework was seen as a strong component of their education.

Concerns centered around the average time to complete a Masters degree (3.4 years), fragmentation of the research effort between JISAO and the on-campus building, and inadequate opportunities for obtaining teaching experience. In addition, the graduate students felt that they would benefit from a clear channel of communication to the faculty on policy issues. Some dissatisfaction was also expressed about the qualifying exam; the students felt uninformed about the process and expressed concern that there was no written material about the exam available to them.

The committee felt that the average time to complete a Masters degree was longer than desirable. Part of this evidently stems from a path to PhD candidacy by producing an "exceptional" Masters thesis, but the phrase "mini-PhD" was used more than once to describe the Masters project. Obviously, this is a trend to be avoided. We encourage the Department to explore mechanisms to reduce (and clarify) the expectations for a Masters degree, e.g., by making available to the students a portfolio which lists past and potential projects.

The physical separation of JISAO is felt throughout the Department, and is a consequence of space constraints. The long-term goal of co-locating all the earth sciences programs in a single building would eventually address this. In the interim the Department should investigate ways to maximize the flow of ideas and personnel between the two facilities.

The strong research program of the Department allows entering graduate students to take an RA upon entry. This is a mixed blessing, in that graduate students do not obtain much teaching experience as TAs. The committee suggests that the Department consider a variety of ways to enhance the preparation graduate students receive for teaching. Examples include offering introductory night classes taught by graduate students, establishing a strong teaching mentoring program within the Department, and establishing a constructive feedback mechanism for informal Departmental research talks delivered by students.

Geological Sciences

Graduate students in the Department of Geological sciences felt their needs were being met by the Department. The track record of placing graduates in faculty and professional positions is strong. The policy of placing students on Departmental committees was highly valued by the students. The Department's students did, however, have a number of concerns and they seemed somewhat demoralized as a group.

One major concern was the lack of RA positions. The committee believes that the total number of RA positions across the Department is considerably fewer than one would hope for a faculty of 24 FTEs (including research faculty). Two effects that contribute to this are underproductive faculty members and the severe budget constraints in the geological program at the NSF. While these are certainly contributing factors, the graduate students felt that most of the burden of raising RA funds fell to them. The students believe that the effort spent as a TA added to the time needed to complete an

advanced degree. The need for TAs is high because of the many undergraduate laboratory courses. In the long term, we hope that the hiring of productive faculty members would correct the imbalance between TAs and RAs. In the near term, the graduate students would benefit from contact with faculty in other earth sciences programs who have joint or affliate appointments and who have better funded research programs. Collaborative research between members of this Department and other units should also be helpful in this regard. The students also felt that there was a lack of communication with the faculty and they decried the "hands-off" nature of the faculty in (not) helping students organize colloquia and finding research projects.

A number of individuals expressed concern at the attrition rate for female graduate students, but the committee did not have sufficient information at hand to evaluate this claim. We were pleased to see that the Department's graduate faculty advisor was attuned to the needs of female students in a Department with a scarcity of female teaching faculty members.

As described elsewhere, the committee feels that the Department could effectively address some of these concerns by moving aggressively to recruit (particularly from the underrepresented talent pool) junior faculty member(s), as "target(s) of opportunity". An orderly process for replacing faculty members should be planned and discussed with the Dean of Arts and Sciences.

The students expressed a desire for the Department to evaluate the merits of a terminal Masters degree for students whose aspirations are to work in the industrial/environmental geology field.

Geophysics Program

The graduate students in the Geophysics Program were in general very pleased with how the Program is meeting their needs. The students remarked on the open climate and healthy faculty-student interactions. The breadth of the introductory graduate courses was seen as a strength, as was the adequacy of RA funds. Furthermore, the students felt that the faculty take steps to address concerns that are raised by the graduate students.

The issues of concern to the graduate students included the physical facilities in Johnson Hall, as with all residents of this antiquated building. The students also expressed a desire to learn more about non-academic career paths, a topic the committee feels could be addressed very effectively across all the Earth Sciences programs.

As the faculty in the Program know well, the one topic that exiting Ph.D. students identified as worthy of attention was preparation for teaching. This is a natural consequence of the limited undergraduate course offerings in the Geophysics Program, which limits the number of available TA positions. Some opportunities exist in other Departments, and particularly in the Geological Sciences Department.

Oceanography

Like the undergraduates, the graduate students appear to be very satisfied with the graduate degree programs offered by the School. Some of them would like to see more chemical oceanography courses. As for the other units, some students (especially those at the Master's degree level) would like to have more teaching experience.

The Master's degree program is a non-thesis one, which both terminal and ongoing students are expected to take. The focus is on a published paper rather than on a thesis; this paper may be the basis for a Ph.D. thesis for ongoing students.

The School appears to be doing all the right things for its graduate students. It is a pleasure to note that both the % of women and minorities have kept on increasing in the School's graduate program.

3.2.2 Instrumentation:

All four units are in need of major instrumentation. Such equipment is expensive, and requires staff and maintenance. The NSF and other government agencies have equipment funds available from time-to-time, but they require 50% matching funds from non-federal sources, as well as the assurance that the equipment has an appropriate location, will see broad use and will be maintained. The four units should get together to determine a prioritized list of major instruments. An example is a multi collector *ICP source* mass spectrometer.

3.2.3 Salaries:

Particularly the outside reviewers point out that the salary situation at the University is extremely bad, leads to an unstable situation (i.e., faculty raids), and could easily destroy the quality of the units being reviewed. They urge the University (as do the internal members) to do all they can to rectify the situation.

3.2.4 Space:

The space that Geological Sciences now has in Johnson Hall is impossible. They need help **now**. Both the undergraduate and graduate students said that they are "turned off" when they enter Johnson Hall. The building hinders effective teaching, especially laboratory courses. Moreover, the committee repeatedly heard the complaint that the water in Johnson Hall was not potable. It is imperative that the University evaluate this claim, and take appropriate action. One of the external reviewers said that he would not believe any analytical result that came out of any Department housed in Johnson Hall.

We strongly urge giving the Department the option to **temporarily** house some of the faculty in either Bagley Hall or in the old Oceanography Building. Splitting up the Department, even temporarily, is highly undesirable, but not as much as to keep them where they are. The added benefit of a temporary move is the proximity to either Chemistry or Oceanography. However, a problem with the Old Oceanography Building is that it is a long way from the cognizant library. Good analytical equipment needs

good space and this is presently not available to Geological Sciences. Furthermore, the present building will not help attract new key faculty members to the Department. If the Deprtmeant is split in this manner, then we hope that in the not too distant future the faculty can be reunited in an Earth Sciences Building.

The quality of all the upper campus units under review would be greatly enhanced by being housed together in an Earth Sciences Building located in the SW corner of the campus near Oceanography. This building should also permit JISAO to be reintegrated into Atmospheric Sciences and Ocean Sciences. We urge that the administration place such a building at the top of the building priority list.

Facility Master Plan Update 1999-2000

The committee endorses the facility Master Plan (Appendix B) that was presented to it by Dean Arthur Nowell. It is visionary, practical, recognizes critical zoning restrictions, and is completely consistent with our view for unifying earth science education on our campus. We emphasize the need and opportunity to renovate completely, at the earliest opportunity, the buildings that have been occupied by Ocean Sciences and Fisheries Sciences units.

4 COOPERATION—MAJOR PROJECTS

One of the purposes of reviewing all four units together (in a marathon session!) was to see in what ways they could and should cooperate. There are already a large number of cooperative, interdisciplinary undertakings between faculty members in the units being reviewed as well as with other departmental colleagues on campus (e.g., Chemistry, Zoology). Examples are Astrobiology, Earth Surface Processes, Geobiology, Global Climate Change, Chemical Oceanography, PRISM, and NEPTUNE. In addition the QRC and JISAO offer opportunities for cooperative undertakings.

We believe that cooperative work or efforts at collaboration on major projects must begin with the faculty. But there may be ways to "get the ball rolling". The Earth Sciences at the University of Washington are all strong, but the sum of their activities could be enhanced if they were to work together on projects which are of interest to students, the faculty, and society.

The earth and its environment offer many opportunities for such collaboration. The Earth Sciences have the potential of playing a major role if they can mount a joint effort to attack such problems.

In considering other opportunities, it is important to realize that biology is an important component for any projects that deal with our earth. The presence of a strong biological section in Oceanography and paleobiology in Geological Sciences provide natural starting points within the Earth Sciences.

A suggested procedure for furthering cooperative efforts:

There are a number of mechanisms to enhance faculty cooperation in both teaching and research. We suggest one possible mode.

Have the faculty design a 5 year terminal MS degree in earth sciences or the earth and its environment. We suggest a 5 year program because we are concerned that a BS based on these broad subjects would offer a lot of breadth but no depth. It is important for a student to have both depth in a given area as well as some breadth. We suggest a 5 year MS degree as one such possible avenue. For instance the first 4 years could be in one of the disciplines covered by this review and the 5th year could provide the breadth. However, there are surely other ways to fashion the program and we believe that the faculty of the 4 units should get together to do so. Such a 5 year terminal MS degree program exists at Stanford University (and perhaps elsewhere) and appears to be quite successful. It would surely be helpful to learn more about this and similar programs elsewhere. We believe that this degree will have considerable interest among the students who attend the University. The proposed degree program should not preclude the development of a minor in earth sciences or the environment.

A possible mechanism for the development of the proposed degree is for the Deans to appoint a steering committee composed of the chairs/director and one other faculty member from each unit. This would keep the committee small enough to get some work done. The advantage of the appointment by the Deans is to make sure that the steering committee's work is taken seriously and will be followed or, at the very least, seriously discussed.

We propose that the same steering committee also develop an initiative on a major research topic that involves several or all of the earth science units being reviewed. In principle the QRC could also be used in this manner, but it has its own mode of operation, which does not lend itself to the task we envision. In order to be able to carry out its mandate, the committee will need to have some resources (similar to the QRC) and the knowledge that some resources can be made available. For the first part, we have in mind the ability of the committee to invite experts (for perhaps even as long as a quarter) , offer a series of seminars, and, if needed, free some faculty from teaching to develop a proposal or to begin work on the project. For the second part, the Deans might hold back a few positions at the appropriate time to hire key faculty members to work on the subject of the proposal we hope will emerge from the committee. Instead of joint appointments, we recommend the hiring of a "team" with one member in each of two or more units related to the interdisciplinary initiative. We also urge the designation of named postdoctoral fellowships in the area of any major joint enterprise. These fellowships could be obtained through fundraising efforts; their availability is a further carrot for the enterprise we are suggesting. These fellowships will also serve to shine the spotlight on the area of the interdisciplinary undertaking and the University to the scientific community through the advertising of the positions.

There are many models that might be followed to foster interactions in the earth

sciences. JISAO (The Joint Institute for the Study of the Atmosphere and Oceans) was established initially for the benefit of NOAA and the faculties of Atmospheric Sciences and Ocean Sciences. Some of its operations indicate its benefits for bringing colleagues from many units together to address a large and multi-discipline issue. We include in Appendix C extracted remarks from Professor Edward Miles who wrote to the internal committee members about his positive experiences in establishing a major interdisciplinary group to address issues of large-scale climate and its many scientific and policy ramifications. The benefits reported by Professor Miles emphasize the importance of having JISAO located conveniently to facilitate interactions between colleagues who could be drawn to a common large problem of considerable societal importance.

A second model to consider is the Quaternary Research Center (QRC). We did not review the QRC, but note that many of its features are relevant for integration of earth sciences. When QRC was established its founding Director had a vision for multiple-disciplinary research related to the quaternary period. Faculty have principal appointments (there are a few exceptions) in one of the science or policy departments and are affiliated with QRC. The seminar series offered by QRC, and visits by distinguished scientists have provided focus for numerous interdisciplinary topical studies over the years. In principle, QRC could provide some of the supportive elements that Professor Miles found attractive for his work that is housed in JISAO. The common thread is identification of a "big problem" and then finding the easiest way to advertise that activity and the simplest way for those who would be potentially involved to contribute. We note that Professor Miles has substantial external support for his activity. The current QRC director has relatively modest State support and suggested to the committee that a possible structure for fostering interactions in the earth sciences might be through an "Earth Surface System Institute", of which QRC would be one part. We note that QRC is a visible activity that acts as a beacon for prospective graduate students particularly in Geological Sciences and Geophysics. A different emphasis might provide visibility for multi-disciplinary non-traditional activity along the lines reported in Appendix C by Professor Miles.

We are not proposing additional administrative structure. Efforts elsewhere, e.g. Columbia University, to establish an Earth Science Institute have not yet been successful, and may prove to be unsuccessful. We suggest that the Steering Committee examine closely the successful elements that professor Miles has reported and look for comparable opportunities across the four units we have examined as well as related units in the natural and policy sciences as well as the Applied Physics Laboratory.

5 CONCLUSIONS

We believe that all 4 units are strong ones, with some stronger than others (as expected). We recommend that degree granting authority should be continued. We urge the units to work together for a new encompassing degree at the Masters level and to help each other in furthering the educational mission of the University in the Earth Sciences.

We believe that if the units forge a closer alliance and work together, the result would be a strength that is much larger than the sum of its separate parts. We have suggested a mechanism for doing so, but this is not unique and the units, working together, may come up with a superior one. If the units make a concerted and serious effort to cooperate, the University can become pre-eminent in the Earth Sciences. We urge the units to meet this challenge.

The University should place an Earth Sciences Building to be located on the SW part of the campus at the top of its priority list; it would clearly help to engender major cooperation and would allow the long overdue renovation of Johnson Hall.

Appendix A : Committee Meeting Schedule

Appendix B : Facility Master Plan Update 1999-2001

Appendix C : Remarks by Professor Edward Miles

UNIVERSITY OF WASHINGTON

The Graduate School

Earth Sciences Program Review
March 11, 12, 13, and 14, 1999
Room C-520 Physics-Astronomy Building

AGENDA

Tuesday, May 11	
7:30 p.m.	**Review Committee Dinner and Executive Session** **Brie and Bordeaux Restaurant - 2227 North 56th, Seattle**
Wednesday, May 12	**Geophysics Program**
8:00 - 8:30 a.m.	Michael Brown, Professor and Chair, and John Booker, Professor and Past Chair
8:30 - 9:00	Space Physics: Gonzalo Hernandez, Robert Holzworth, Michael McCarthy, George Parks, and Robert Winglee Solid Earth: Ronald Merrill
9:00 - 9:30	Atmospheres: Marcia Baker and Brian Swanson Glaciology: Charles Raymond and Edwin Waddington
9:30 -10:00	Robert Holzworth, Professor, Graduate Program Coordinator, and cohorts
10:00 - 10:30	Coffee break and meet with Geophysics Graduate Students
10:30 - 11:00	Solid Earth/Semsmology: John Booker, Kenneth Creager, Robert Crosson, James Mercer, Robert Odom, and Anthony Qamar
11:00 - 11:30	Public Service/Outreach: Janice DeCosmo (Washington Space Grant) Stephen Malone (PNW Seismic Network)
	School of Oceanography
11:30 a.m. - 12:00 p.m.	Richard Sternberg, Professor and Director, and Arthur Nowell, Dean, College of Ocean and Fishery Sciences
12:00 - 12:30	Bruce Frost, Professor, Graduate Program Coordinator, and cohorts
12:30 - 2:00	**Lunch - Review Committee** **Faculty Club Conference Room (Lower level, reserved)**
2:00 - 2:30	Oceanography Graduate Students
2:30 - 3:00	Hydrothermal Processes, Related Programs: John Delaney, and Laurie Bryan for Richard Sternberg Russell McDuff, Marvin Lilley, John Baross, Jody Deming, Kathryn Kelly, William Wilcock, Paul Johnson, and Ross Heath
3:00 - 3:30	Biological Oceanography: Bruce Frost and cohorts

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AGENDA

	School of Oceanography (continued)
3:30 - 4:00 p.m.	PRISM: Jeff Richey and cohorts
4:00 - 4:15	Break
4:15 - 4:45	Della Rogers, Undergraduate Program Advisor, and Richard Sternberg
4:45 - 5:15	Chemical Oceanography, Global Environmental Chemistry: Jim Murray and cohorts
5:15 - 6:15	Review Committee Executive Session
6:30	**Review Committee Dinner with Designated Faculty from the Four Academic Units: Faculty Club – South Dining Room (Reserved)**

Thursday, May 13

8:00 - 8:30 a.m.	Oceanography Undergraduate Students
8:30 - 9:00	Earth Surface Processes, Ties to Geological Sciences: Chuck Nittrouer and cohorts
9:00 - 9:30	Physical Oceanography: Charlie Eriksen and cohorts
	Department of Geological Sciences
9:30 - 10: 00	Mark Ghiorso, Professor and Chair, and Darrel Cowan, Professor and Past Chair
10.00 - 10:30	Coffee break and meet with Geological Sciences Graduate Students
10:30 - 11:00	Bruce Nelson, Professor, Graduate Program Coordinator, and cohorts
11:00 - 11:30	What we do well and what we need to maintain excellence: Darrel Cowen and cohorts
11:30a.m. - 12:00 p.m.	George Bergantz, Associate Professor, Undergraduate Program Advisor and cohorts
12:00 - 12:30	Geological Sciences Undergraduate Students
12:30 - 2:00	**Lunch and Review Committee Executive Session Faculty Club Music Room (reserved)**
2:00 - 2:30	Facilities and Technical Infrastructure: John Stone and cohorts

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AGENDA

Department of Geological Sciences (continued)

2:30 - 3:00 p.m.	Curriculum, Undergraduate Program, Graduate Program: Stuart McCallum and cohorts
3:00 - 3:30	Future Directions and Hiring Plans: Bernard Hallet and cohorts

Department of Atmospheric Sciences:

3:30 - 4:00	James Holton, Professor and Chair, and Norbert Untersteiner, Professor and Past Chair
4:00 - 4:30	Coffee Break and meet with Atmospheric Sciences Graduate Student Representatives
4:30 - 5:00	Dale Durran, Professor, Graduate Program Coordinator, and Kathryn Stout, Academic Counselor
5:00 - 5:30	Mike Wallace and Dennis Hartmann
5:30 - 6:30	Review Committee Executive Session
6:45	**Review Committee Dinner** **Marlai Restaurant – 3719 NE 45th, Seattle**

Friday, May 14

8:00 - 8:30 a.m.	Clifford Mass, Undergraduate Program Advisor, and Mike Wallace, Co-Director, Program on the Environment
8:30 - 9:00	Atmospheric Sciences Undergraduate Students
9:00 - 9:30	Robert Brown and Conway Leovy
9:30 - 10:00	Dean Hegg, Robert Houze, Sandra Yuter
10:00 - 10:15	**Break**
10:15 - 10:45	Thomas Grenfell, Gary Maycut, and StephenWarren
10:45 - 11:15	Dale Durran, Gregory Hakim and Clifford Mass
11:15 a.m. - 12:00 p.m.	Open for last minute arrangements—e.g. visit to various locations to examine space is one possibility.

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AGENDA

12:00 - 3:00 p.m.	**Review Committee Executive Session** **Lunch - (To be catered to conference room.)**
3:00 - 4:00	Exit Interview Debra Friedman, Associate Provost for Academic Planning Marsha Landolt, Dean and Vice Provost, and John Slattery, Associate Dean for Academic Programs, The Graduate School David Hodge, Dean, and Gary Christian, Divisional Dean for Sciences College of Arts and Sciences Arthur Nowell, Dean, College of Ocean and Fishery Sciences Frederick Campbell, Dean, Office of Undergraduate Education Department Chairs / School Director: Professors Michael Brown, Mark Ghiorso, James Holton, and Richard Sternberg
4:00 - 5:00	Exit Interview Associate Provost for Academic Planning, Deans of The Graduate School, College of Arts and Sciences, College of Ocean and Fishery Sciences, and Office of Undergraduate Education

Facility Master Plan Update 1999-2001

Stated in the simplest strategic terms, the University has a chance with Southwest Campus to develop an integrated vision for the location of intellectually related and collaborative programs for the earth and environmental sciences. The future national leadership of these programs will rest upon their infrastructure. The first two buildings on this large development site are being constructed now for Fisheries and Oceanography. It would prove a bold stroke if the Southwest Campus could become the environmental center housing the units involved in the earth sciences. Without such a strategic decision, Southwest Campus will become an amalgam of buildings housing research unrelated to our undergraduates and the ties among faculty in the environmental and earth sciences will be strained and never achieve their maximum contribution to our undergraduate and graduate education programs.

The Southwest Campus also has the last waterfront sites. City Code regulations limit the use of these sites to water-related uses. The chance for relocating the Fish Hatchery from beside the Montlake Cut to Southwest campus and to use the waterfront for public involvement/access in science and environmental science education is an outreach opportunity that must not be ignored.

Deficiencies in Facilities: Statement of the Problem

The College of Ocean and Fishery Sciences will derive its continued success in large measure from its ties to the many programs on campus that complement our activities. Oceanography with the other earth sciences, Fisheries with Forest Resources are the most obvious examples. These ties lead to such programs as PRISM (the Virtual Puget Sound UIF that is attempting to synthesize and display the accumulated modeling expertise and data bases that have been developed around campus) and will lead to other similar collaborations. With our facilities located in the Southwest campus we have to strive to ensure this new development zone becomes the location of the developing academic programs that are intellectually related and not just an expansion site for the research health sciences.

For want of a nail..... *Complete the Two New Buildings*

The magnitude of the deficiencies we face are quite unknown at this time. Two new buildings are under construction. The total budget deficit to complete the buildings as planned is now approximately $6 million. To complete the buildings within the present allocated budgets will likely mean 'shelling' various labs, offices, classrooms, and indeed whole floors may not be completed. There is no 'furniture budget' left for the Oceanography building. Hence it will be an empty shell, truly because of the want of a nail. This deficit is in part due to very high inflation costs recently emerging in the construction business. The impacts however are monumental. Without completing these buildings the entire goal of coalescing the Oceanography faculty who need chemistry labs from three buildings where labs up to 60 years old are still in use will be lost. Similarly, the Fisheries faculty are spread over a quarter-mile separation and the inability to complete the new building will mean the faculty cannot be brought together.

The new Fisheries building was to have a state-of-the-art classroom suitably equipped for distance learning transmission and computer based learning. The University has identified the marine lab site at Friday Harbor and the marine resources site at the Olympic Natural Resources Center in Forks as top priorities for video-conferencing linkages, satellite downlinks and 10 T-1 lines. Without the suitably equipped base here on campus we will have the situation of a modern facility off-campus and nothing on campus in which to link our faculty and the outside.

These two examples of the impacts of not having sufficient funds for completing the two new buildings are small problems in comparison to the past. But these two new buildings were part of a well-constructed sequence of building construction and then renovations that would result in the optimal use of the space that is vacated. We currently have no shared undergraduate computer lab. When the Technology Fee Initiative was proposed this College had to request the Library to give up space so that we could put a small cluster of computers somewhere for our students. Our renovation plans would make such spaces available in the two buildings we will be partly vacating when the new construction is complete.

For want of a shoe.... Renovate Old Ocean, Fish and Marine Studies

The renovation of space in buildings currently occupied by the College units is a crucial step in the logical and fiscally responsible methodology of providing space for access, excellence and innovation. Approximately 12,000 sq. ft. in Old Ocean, 6,000 sq. ft. in Marine Sciences, 20,000 sq. ft. in Fisheries Center and 3,000 sq.ft. in Marine Studies could be renovated to provide the needed teaching space for our undergraduates, accommodate the successful interdisciplinary programs in Marine Affairs and provide adequate laboratories for many of the biological oceanography faculty who will not be moving into the new buildings.

For want of a horse.... Plan for the Waterfront: A New Hatchery

The waterfront zoning code requires us to use this very limited part of campus for water-related activities. Our long-term teaching and research involvement in managing scarce natural resources must be better shown in a commitment to public education in environmental and natural resource issues. A real Waterfront Activities Center, one that focused on research and public education rather than just recreation, where undergraduates could work on such visible projects as returning salmon in an urban area, the water chemistry of urban lakes such as Lake Washington, the hydrodynamics of strongly stratified fjord estuaries such as Puget Sound would act as a powerful resource for our community and a powerful signal of our commitment to working with our community. Such a facility would tie K-12 students into our natural resource and environmental education programs. It could be a shared facility in the same way that the Burke Museum is a shared facility...a public gallery and a research facility.

For want of a rider.... An Academically Defensible Plan for Southwest Campus

The University of Washington is positioned to lead the nation in global geosciences. NEPTUNE is just one example of a project that has the highest visibility in the University and can impact all areas of the earth sciences and our society. There are excellent faculties in the earth science departments and there occurs now several

overlapping opportunities on which we might capitalize. The Joint Institute for the Study of Atmospheres and Oceans has an outstanding record of research in EL Nino-related climate and recently added a large policy component to its studies. This group forms the basis for a larger climate change group on campus. The Polar Science Center brings faculty from the Applied Physics Laboratory and Geophysics/Atmospheric Sciences together and it is in the polar regions that the effects of global climate change are to be seen most immediately and emphatically. The recently developed Surface Process Initiative bringing together the School of Oceanography and Geology will play a key role as it grows to include not just fluvial processes but earthquake and volcanic processes (episodic events that do indeed shape the Pacific Northwest). The emerging opportunities afforded by studies of Puget Sound (PRISM) and of the Juan De Fuca Ridge with its hydrothermal system (NEPTUNE) can give UW a unique ocean observatory on a region where life may have originated away from sunlight and photosynthesis. Putting these together, coupling them with the vast Japanese initiative in Global Prediction could mean a new international center located on southwest campus and at Sand Point. This is a unique opportunity, worthy of the kind of political vision demonstrated when Warren Magnusson facilitated the Health Sciences Buildings. It would build our ties to other Pacific Rim nations and capitalizes on our established academic strengths and those of our partners in Seattle such as NOAA.

The southwest campus could become a center for environmental and natural resource sciences on this campus. It could act as the locus for the many interdisciplinary programs that attract our undergraduate and graduate students. The College of Ocean and Fishery Sciences and all its faculty want to work collaboratively with our faculty colleagues in the many departments on campus to build healthy and diverse programs which focus not just on the physical and biological sciences of our planet but also engage in the much needed study of the societal and policy implications of our developing world. I urge the campus as a whole to look at how we can unify fields by relocating departments over the next fifteen years bringing those with conjoint interests into close proximity.

The additional benefits of freeing up space for the social sciences in the central core of campus is an added bonus of this plan. Absent a compelling vision for the interllectually defensible use of Southwest campus, I believe the faculty and students on the campus in 2050 will look back and ask, "How could they have been so short-sighted? Was all they cared about getting another NIH grant?" I hope the legacy of efforts to bring the earth sciences into closer collaboration can also lead to a compelling vision of how to use the last large area of campus in a way that reflects the commitment of the people in the State to their environment and quality of life.

Appendix C

Extract of remarks provided by Professor Edward Miles to the Internal Committee members, May 4 1999

.. here are my thoughts about JISAO and fostering collaboration between Ocean Sciences, Geophysics, Atmospheric Sciences, and Geological Sciences.

I wanted to be in JISAO because I was determined to ground the project–an integrated assessment of the impacts of climate variability and climate change in the Pacific NW–in the climate dynamics of the region and therefore chose JISAO as a multidimensional entity linking Atmospheric Science, oceanography, fisheries science, and hydrology. Mike Wallace (the then director of JISAO) was willing to host a fully integrated natural science/social science/law team to do integrated assessment of climate impacts as it should be done, therefore I had no difficulty adding people from SMA, economics, forestry, public health, etc. The effort is in fact a partnership between JISAO and SMA and the Climate Impacts Group is now fully a part of the Hayes Center, making that Center the only fully operational end-to-end climate prediction and assessment center in the world. ..

Because this is a research effort with its own money supporting faculty and graduate students across a wide-range of departments/Colleges within the University, we don't present difficult organizational problems for the Administration at any level. ...But the University as a whole gains immensely by having a mechanism which has been widely reviewed at the national level and is seen to be a very high quality operation which makes the whole greater than the sum of its parts. We also feel warmly and effectively supported by the Vice-Provost for Research.

The more successful we are on the research side, the more collaboration we undertake in an organic fashion with different disciplines within and outside of the University and the more graduate and undergraduate students are excited by the work we do. Consequently, we now have a steady stream of potential new recruits who either want to blend the science and the policy/ management aspects after they complete a Ph.D. in one of the Earth Sciences and are therefore looking for post-doc positions (we just hired someone from Oceanography/Chemistry), or they want to do a very atypical Ph.D. blending Oceanography, Atmospheric Science, and one of the social sciences. It remains to be seen whether the University will be flexible enough to permit this kind of innovation to occur but a mechanism for accomplishing such a hybrid without relaxing quality control was actually elaborated in the report of the President's Task Force on Environmental Education which I chaired. As a deliberate alternative to the Individual Ph.D. option in the Graduate School, which met a mixed reaction in the Task Force, the recommendation was for oversight of these untypical Ph.D's to be provided by a consortium of operating units on the basis of a contract to be negotiated between the student, the inter-unit faculty committee, and the Graduate Program Coordinator of the home unit. Such a student would never be an orphan, as has often been the case in the of the Individual Ph.D. program, and each unit would be required to negotiate and buy off on a stipulated

program of work. There are people knocking on our doors right now from Columbia and from UW for next fall and I sincerely hope we can pull this off.

Yale University

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June 3, 1999

Professor Ernest Henley
Department of Physics
University of Washington
Seattle, WA 98195

Dear Prof. Henley:

Here are few personal comments concerning the geoscience program at UW, to highlight some issues raised in the Earth Science Committee Report.

The overall quality of the geoscience program at UW is very high, as I anticipated from the reputations of the four departments across the country and internationally. Atmospheric science and oceanography are probably in the top three nationally while Geophysics and Geology are at least in the top 15. This level of excellence of four related departments within one university is an extraordinary achievement and, it is a significant asset to the people in the state of Washington; both in service and in education. It also represents a tremendous bargain as the annual funds provided by the state are a small fraction of the total budget of these units. This efficiency is possible because of the entrepreneurial spirit and creative energies of the faculty and staff in geoscience.

It should be added that the area of geoscience is a very active one today. Most major universities are striving for excellence in geoscience (and also life science) even if it means moving a little slower in some of the more traditional disciplines. Thus, it is all the more impressive that UW has reached such a high level. It also means however, that future success cannot be taken for granted as the pressure from competitors continues to grow. Our committee tried to identify issues which might need attention in the near future to avoid any slippage in UW's enviable position.

I was also impressed by the undergraduate programs of these departments. Especially in Geology and Oceanography, undergraduates are taking great advantage of undergraduate laboratory and research opportunities. Atmospheric Science has a smaller undergraduate program. They too try to give student research experience but the program is less organized and not universal. Geophysics, while it has no undergraduate program, is actively engaged in experiential activities through the Space Grant program.

While there is significant collaboration between departments, more will be needed in the future. Both the pattern of funding and the science itself are becoming more interdisciplinary. Broad groups that communicate well will have an advantage in this new marketplace, if they can maintain their disciplinary strength and rigor as well. Successful initiatives like Earth Surface Processes should be viewed as a models for the future. A new 5-year BS/MS program in Earth

Science, involving all four departments (and perhaps Zoology too) could interest undergraduates. Joint planning for major instrument purchases will improve the chances of success. Cross training of undergraduate and graduate students would improve their intellectual development and chances of employment.

An idea for enhancing collaboration was put forward by the Committee: the formation of a geoscience steering committee. This 8-person committee would be composed of the chair and one other faculty member from each of the four departments; appointed by the Dean. Its objectives could include:

1. Run an annual search for a two-year Post Doc position in Geoscience.
2. Promote interdisciplinary research initiatives (buy out faculty time for proposal writing)
3. Promote dual hiring initiatives
4. Oversee a 5-year BS/MS program in geoscience
5. Promote cross-over of TA and RA opportunities between departments
6. Publish an annual Undergraduate Guide to the Geosciences at UW
7. Coordinate joint requests for major equipment requests and support (e.g. ICPMS, aircraft etc.)
8. Advise the administration on issues of lab/office space and attempts to collocate the groups
9. Report annually to the Dean and the departments on the state of the geosciences at UW

In spite of tight UW budgets, some state or private investments will be required to retain leadership in the geosciences. Experience at UW indicates that such investments bring significant additional federal funds to the university. The space issue requires some immediate attention. The separation of JISAO from the department of Atmospheric Science has seriously hurt the intellectual climate and day-to-day efficiency of these units. The poor condition of Johnson Hall is effecting research and recruiting in Geology. Physical collocation of the four departments should be sought. Matching funds and technical support are essential for any institution seeking to remain at the leading edge, even though these items are becoming more expensive. In important fields, hires in anticipation of retirements are needed to maintain strength. Low faculty salaries put UW at risk of losing critical faculty to other institutions.

Brief comments on individual departments:

Oceanography: top three; good recruiting; well funded; active with new initiatives; good buildings; needs to follow its plan and target new hires in new fields; few problems

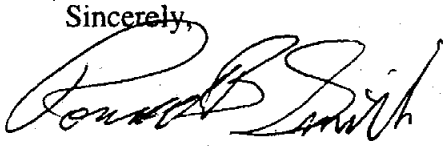
Atmospheric Science: top three; good recruiting; well funded; well positioned for new climate initiative; little long range planning; split JISAO is a problem; MS degree time is too long; undergraduate program needs to be broader and a higher priority; dept. must maintain a strong observational capability

Geophysics: top ten; strong funding; active faculty in mid/late career; eclectic mix of disciplines held together by methodology; brings talented students interested in physics and measurement into the geosciences; too few TA opportunities; students need some broadening in geoscience

Geology: top fifteen; some strong areas; some core areas of geoscience are in this department; good recruiting; students need more geophysics training; research funding variable across department; NSF runs a tighter program in this area; needs new space and some new equipment; new earth surface initiative is impressive

Finally, let me say how much I appreciated the smooth running of the committee and the effort made by the departments. While a three-day visit is clearly insufficient to understand the details of each department's scholarship, I felt that the department representatives and internal committee members helped us to understand the issues facing each unit. It was a pleasure for me to see how this successful organization works.

Sincerely,



Ronald B. Smith
Professor

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Department of Geology and Geophysics

June 9th 1999

Dr. M.L.Landolt,
Dr. D.C.Hodge,
Dr. A.R.M. Nowell,
Dr. F.L. Campbell
University of Washington,
Seattle, WA 98195

Dear Deans,

I write as an external member of the committee to review the earth sciences departments, to give opinions on matters which particularly struck me as important. My perspective is that of a working marine geologist and former head of a major research department of Earth Sciences.

1. In the last 20 years there has been a trend to the amalgamation of small geology, geophysics,mineralogy, palaeontology and cognate departments into large departments or Schools of Earth Sciences. This has occurred when the members of the departments have perceived that the intellectual map of the Earth Sciences is changing, and has become more unified by the deeper understanding of earth behaviour represented by theories of plate tectonics and Milankovitch forcing of climate, among others. Notable examples have been my department in Cambridge and the department I have been visiting at M.I.T. However, without that intellectual convergence, a shotgun marriage can accomplish little but administrative convenience.

2. I am very clear that the housing problems of the departments, Geology and some Geophysics in Johnson Hall, and JISAO separated from all relevant departments, is a major impediment to your maintaining international standing in these subjects in the next decade. The four departments under review, with the QRC, have much in common and would probably have more were they housed contiguously. Given the inertia involved in new buildings they will have to do the best they can for at least the next half dozen years. But what do you expect them to be doing in the second decade of the next century? Still trying to keep dirt out of the clean labs, filtering the water etc? The University must set as a high priority getting these departments onto a common site, which, since Oceanography is already there with a new building, should be on S.W. Campus. If the first half of this century has been dominated by Physics and the second by Molecular Biology, it is a pretty fair bet that the first half of the next will be by the Environmental Sciences. If affairs are set on a secure foundation, by 2020 you might find yourselves with a world class College of the Environment in which the whole was greater than the sum of its parts.

3. On a smaller scale, your Department of Oceanography shows what is possible in the way of interdisciplinary research in the environment. It contains geologists, geophysicists, biologists, chemists, applied mathematicians, observational physicists and numerical modellers. They have successfully entrained the efforts of associated staff at NOAA and the APL. The latter in particular fulfils a need in the field of engineering and instrument development for which some institutions have a separate department. The efforts of this vibrant grouping are eminently deserving of continued support.

4. A distinguished US climate modeller wrote "good models follow good data. One good observation is worth a thousand simulations". One might remark "and is just as costly". Because of that, some departments have pulled back from the frontier of measurement in favour of the backroom of modelling. In the best enterprises these go hand in hand. All the units we reviewed have excellent observational capabilities, but these can be fragile and need to be encouraged and maintained. As with any edifice, there is a profound asymmetry involved in construction/destruction in that it may take years to build up a high class observational or experimental capability but only a year or so to destroy if the necessary continuity of timely staff replacement and equipment funding is not maintained. I think this applies to all the units under review.

5. You do a good job in undergraduate education. It is important to keep the basic sciences (M, P, C & B) component of the degrees as high as possible, especially during the first two years when a secure foundation must be laid. Because the environmental sciences are applied, the opportunity to do minors in them alongside basic sciences provides excellent preparation for Graduate School.

However I feel that the time taken to both the MS and PhD reflects something structurally wrong (but I note you are not alone!). I managed to get a Ph.D. from a US University inside 4 years, and even granting that I had a more specialist undergraduate training in the UK, it should be out of the ordinary for students to take over 5 years to the PhD. It seems to have become the norm for the PhD to take ~6 years, and there may be vested interests and financial benefits for some of those involved. But I believe that more than lip service (of which there is no shortage) should be paid to ensuring that students complete the graduate program in a timely fashion. It is not necessary for a student to know everything, or to have taken courses in every conceivable area related to their work. A course is no substitute for a highly developed ability to find out for oneself. This seems to me to be an area for your decanal leadership, for it is not simply a departmental matter.

Junior faculty have a hard time in having to initiate many new activities simultaneously. If there is to be a mixture of 6 and 9 month support, an ideal system would allocate 9-month support to them *together with a reduced teaching load*. More senior staff should in many cases be able to thrive on 6-month support, depending on policy of funding agencies. I think you should do more for junior staff in the 5 years from first appointment.

The fact that your salaries are well known to be low does not make it alright. In your departments that rank among the best in the world I think you need to see what might be done

differentially within the University so as to recognise and perpetuate that position. Otherwise you may well find you have difficulty in attracting and retaining the best staff.

I want to commend to you most strongly the notion of coupled pairs (at least) of appointments rather than single joint appointments. The latter are sometimes successful, and indeed we saw some outstanding cases, but in others the appointee sits almost exclusively in one location. I have seen this in my own institution.

Finally, I must commend your departments for the training they give undergraduates in practical observation of the environment. It is my experience that everywhere the funds for fieldwork are under attack, generally by small decrements. I come across too many cases where expensive laboratory techniques are being applied to samples that are poorly chosen from an inadequately understood field situation. A good appreciation of field situations is a high educational priority for the environmental sciences. I urge you to maintain the funding for this aspect of your undergraduate education. It is an area that in my university has been attractive for both private and industrial donors

Yours sincerely,

Professor I. N. McCave

cc: Committee, by e-mail.

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August 16, 1999

Dr. M. L. Landolt,
Dr. D. C. Hodge,
Dr. A. R. M. Nowell,
Dr. F. L. Campbell
University of Washington
Seattle, WA 98195

To the Deans:

Here are my personal views as an external member of the review committee for geoscience programs at UW.

As an outsider I was very impressed with the overall quality of these four programs, with Oceanography and Atmospheric Sciences in the top three nationally, Geophysics in the top ten, and Geology in the top fifteen. It's especially remarkable given that UW salary levels are low relative to the competition. Since geosciences is an attractive area, expanding at many universities, UW needs to be concerned about competition for their top people.

UW has the broad-based excellence required for success in the interdisciplinary research programs that are likely to dominate the future in geosciences. It is important to facilitate broad collaborations in the geosciences at UW, and provide resources for such initiatives when they arise. Certainly, bringing the four programs into closer physical proximity would help tremendously. The Johnson Hall space is totally inadequate. A short term solution needs to be found if no permanent solution is coming soon. Moving the instrumentation that require good facilities to more suitable space near the new Oceanography building may be a good start.

Besides geosciences there is a major new scientific thrust at NASA towards the origins of life (Astrobiology), and the search for evidence of life on other planets (e.g. Mars and Europa) and around other stars. For UW geosciences this could present an exciting scientific opportunity. The conditions for life involves coupling between a planet's magnetosphere, atmosphere, surface geology, water, etc., and thus a broad interdisciplinary approach (perhaps involving biology and astronomy) is needed.

UW is doing a very good job in the education of geoscience students, both undergraduate and graduate (Oceanography is particularly outstanding). The time appears ripe for an interdisciplinary approach to geosciences education, and I am in full agreement with the

proposed 5 year BS/MS geoscience program to retain the depth of the core BS programs and providing the breadth.

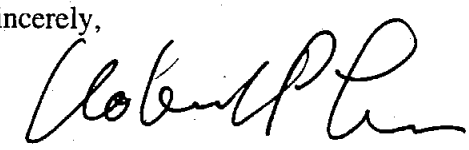
Geophysics can play a larger role in undergraduate education; it already plays a significant role through the excellent Space Grant Program which it administers. A particularly attractive aspect of this program is that it provides research opportunities for outstanding undergraduates. It seems to me that geophysics should be part of the basic education of Geology undergraduates, and they should take one or more geophysics courses. The Geophysics program should also participate in the proposed new five year interdisciplinary MS program in geoscience.

On the other hand, the rigorous (and mathematical) physics training required of Geophysics graduate students sets them apart from Geology students. The Geophysics program has been very successful at providing a good education for its students, with the exception of providing teaching experience. With more undergraduate involvement by the program, there could be more opportunities for Geophysics students to TA.

I strongly believe that it is necessary to maintain the experimental efforts in the geosciences, and strengthen them if possible. Both in Atmospheric Sciences and Geophysics, there are key faculty leading important experimental programs (for example, the airplane program and space plasma physics program, respectively) who are approaching retirement age. These programs have achieved success by providing a critical mass through a combination of faculty and research personnel, so maintaining critical mass and continuity at the top is essential. To survive in these competitive research areas, I strongly recommend that early hiring of replacements be made so that there can be some overlap.

Finally, I wish to express my appreciation for the hospitality and efficiency of the operation of the committee (Professor Henley in particular was an outstanding chair).

Sincerely,



Robert P. Lin
Professor of Physics and Director of the Space Sciences Laboratory

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23 August 1999

Professor Marsha L. Landolt
Dean and Vice Provost
The Graduate School
University of Washington
Seattle, WA 98195

Dear Vice Provost Landolt:

As an external member I endorse the report of the committee you appointed to review the degree programs offered by the Department of Atmospheric Sciences, the Department of Geological Sciences, the Geophysics Program, and the School of Oceanography. Even after a couple of rounds of email exchanges, however, I still differ with the report on a few issues, so my endorsement is not wholly unqualified.

Committee operation. As a veteran of a multitude of committees over the years, I was extremely impressed with the operation of this one. Organization, logistics, and execution were uniformly outstanding. Professor Henley and Ms. McCaffery deserve absolutely the highest marks for their extraordinarily effective and efficient handling of the business of the committee.

I would, however, question the practice of having the internal members of the committee meet extensively with many of the same people who subsequently met with the full committee. Although this procedure undoubtedly contributed to the efficiency of the meetings of the full committee, it also led to factual statements and recommended actions unexpectedly appearing in the draft and final versions of the committee report that were nowhere mentioned in the written materials, oral presentations, and committee discussions seen by the external members.

State support. The University of Washington is a research university of indubitable international repute; and the four geoscience units under review contribute in full measure to its reputation. Indeed, the combination in a single institution of the strengths represented by these four units is truly exceptional. Maintaining these strengths, or, better yet, enhancing them, should be given high priority. In particular, additional funds will be needed to bring faculty salaries up to competitive levels, to meet matching requirements for new equipment, to upgrade existing buildings and construct new ones, and to improve library resources and other infrastructure.

Unfortunately, such funding mainly has to come primarily from the State, and it is not apparent to me that the State is very enthusiastic about supporting a research university, much less a great one, despite the readily demonstrable public benefits. About all I can suggest is to redouble efforts to cultivate and educate alumni, such as Geological Sciences is now doing at its annual awards gathering, in order to build stronger political support. The administration could help, if it is not already doing so, by educating unit chairs and directors as to why and how to conduct such efforts and providing support to carry them out.

Faculty salaries. The committee did not systematically investigate faculty salaries. Nevertheless, in the course of its work it saw data that clearly show that salaries are well below those for similar appointments at comparable universities. Although salary is not the only factor motivating faculty to come and to stay, particularly at the University of Washington, it can become important if it is too low relative to the market. Now that the competition is again hiring, the University of Washington, I believe, is becoming dangerously vulnerable to raiding that will selectively pick off its best faculty.

Johnson Hall. The dilapidated state of Johnson Hall obviously hinders effective teaching of courses in the building, especially laboratory courses, which are a central component of training in the Geological Sciences. It prevents the installation and use of such indispensable modern research instrumentation as mass spectrometers. It surely has a decidedly negative impact not only on the morale and productivity of the present faculty members and undergraduate and graduate students who must work and study in the building but also on their recruitment in the first place. Clearly, Johnson Hall is a critical problem that needs immediate attention.

New building. I completely concur, therefore, with the recommendation that a new Earth Sciences Building be placed at the top of the University's priority list. I also concur with the recommendations that this building house not only Geological Sciences but also QRC, Geophysics, Atmospheric Sciences, and JISAO and that it be located close to the new Oceanography Building. I believe that these recommendations are the most important in the entire report. Concentrating all of these units and their associated activities in closely-proximate, modern facilities would enable the University to take maximum advantage of its unique breadth and strength in the geosciences.

Interdisciplinary activities. The administration of the University seems to me to be quite concerned with increasing interdisciplinary activities among the geoscience units. This concern is reflected in the charge to the committee and in much of the documentation submitted to it. That this concern is not new is indicated by the existing large number of interdepartmental adjunct appointments and mind-boggling array of acronymic interdisciplinary programs.

Personally, I think such programs should have a less-formal status and a more-transient nature. Nevertheless, I see far more interdisciplinary activity and cooperation in the geosciences at the University of Washington than anywhere else I have been, not only in the existence of this multitude of interdisciplinary programs but also in a remarkable degree of informal interdisciplinary interest and effort by faculty and students.

Oceanography, for example, has made me more than welcome over the years in using facilities at the Friday Harbor Laboratories even though I am a geologist and not from the University of Washington. Professor Dunne's surface processes seminar in Geological Sciences regularly attracted participants from Geophysics, Engineering, and Forestry. The Geological Sciences weekly departmental seminar also on occasion attracts audience from other departments, and the QRC seminars regularly do. The seminar offered by QRC this spring on *Mountain Building and Climate Change,* for example, attracted participants from Geological Sciences, Geophysics, Atmospheric Sciences, Oceanography, and Engineering.

In short, the amount of intellectual exchange and degree of collegiality I see among the four reviewed units and with other units, such as QRC, Forestry, and Engineering, already is far above the norm for

similar units elsewhere. I think this is greatly to the University's credit. What is needed is not more research institutes or other special organizational units but instead some means of recognizing and encouraging the faculty generating and participating in this intellectual exchange and collegial activity.

Steering committee. I wholeheartedly agree that the joint steering committee idea proposed in the report be tried insofar as it applies to the development of "a 5-year terminal MS degree in earth sciences or the earth and its environment." The only change I would suggest is designating the degree as "professional," rather than "terminal." I do not agree, however, that "the same steering committee also develop an initiative on a major research topic that involves several or all of the earth science units being reviewed."

I seriously doubt that a committee appointed to do so is likely to develop a truly original and fundamental initiative. It is like appointing a committee to make a major scientific breakthrough. Moreover, the University already has a plethora of interdisciplinary initiatives and programs in the geosciences, so it seems to me that one more is not going to make much difference, except to become still another organizational unit needing University funds and facilities.

I think that instead the route to greater interdisciplinary involvement is through the slower and harder strategy of purposeful selectivity in appointments, as exemplified by the joint faculty hiring initiative in Earth surface processes currently being carried out by the Deans of the Colleges of Arts and Sciences and of Ocean and Fisheries Sciences. The proposed steering committee could play a vital role in this strategy, not only by providing guidance as to direction, but also by judiciously selecting the seminar series, invited experts, and postdoctoral fellows that the report also proposes. The committee's job, as I see it, should be not to develop interdisciplinary collaborative research initiatives itself but to create the conditions that will stimulate the faculty at large to develop them.

Healthy evolution. It seems to me that an underlying assumption in the committee report, the self-evaluations, and much of the other material submitted for review is that "interdisciplinary" is somehow intrinsically good, whereas I think it can be good or not as the case may be, just as "disciplinary" can be good or not. A more important issue, as I see it, is not how to foster interdisciplinary endeavors but instead how to promote the healthy evolution of the four reviewed units as their sciences evolve.

This is a very difficult problem, because universities inherently change slowly, except during periods of unusual growth, as during the 1960s. Moreover, even when positions are available, the practical necessity of getting the courses taught and the essential impossibility of discerning where the science will be twenty years down the line weigh powerfully against radical departures. I think the best course is to try to hire faculty with the capacity and propensity for healthy evolution into new directions in their own scientific work. I realize this is more easily said than done, but nevertheless I think the issue should at least be explicitly considered in every hiring and tenure decision.

Women faculty. The committee report recommends that Geological Sciences "should make a concerted effort to hire more women as regular faculty members," comments that "Atmospheric Sciences suffers somewhat from the same problem but may be on its way to correcting it," and says nothing on the subject concerning Geophysics and Oceanography. I do not see how the facts, at least insofar as they can be gleaned from the information presented to the full committee, can be construed as justification for these statements and nonstatements.

Geological Sciences currently has one 1.00-FTE woman associate professor. In 1998 it appointed a woman assistant professor (listed in the *1998/2000 General Catalog*) who no longer is on the roster. Thus, it appears to me that, contrary to the implication of the recommendation, Geological Sciences is in fact trying to hire more women as regular faculty members, in accordance with the goal stated in its self-evaluation that "a more competitive effort must be made to hire successful, top-quality women to the faculty."

Atmospheric Sciences currently has one 0.33-FTE woman full professor, a fact that does not seem to me to accord with the phrase, "suffers somewhat from the same problem." In its self-evaluation it said, "We continue to make efforts to increase faculty diversity, but ... it will be a challenge to substantially increase underrepresented groups during the next decade." As far as I know, nothing was presented to the full committee to justify the conclusion that Atmospheric Sciences "may be on its way to correcting" the problem, though of course the internal members may have been aware of unannounced impending appointments.

Geophysics currently has one 0.67-FTE woman full professor, the same woman as in Atmospheric Sciences. Its self-evaluation says nothing about hiring women faculty.

Oceanography currently has at least five women as regular faculty members, several of whom are assistant professors. Thus, it appears to me that Oceanography not only is trying but also is succeeding.

Giving Atmospheric Sciences the benefit of the doubt, my conclusion is that the report ought to have recommended that Geological Sciences and Atmospheric Sciences need to continue making concerted efforts to recruit more women as regular faculty members and that Geophysics needs to begin making such efforts.

Professional training. Nearly all the student groups who talked to the committee communicated a desire by many Bachelors and Masters students for more recognition on the part of the faculty that they are aiming for professional careers, rather than doctorates and academic careers. I have to admit that I am not entirely sympathetic to these students, who, as some told the committee, came to the University because they wanted to be taught by famous research professors. Nevertheless, I think that, for the same reasons the reviewed units should cultivate their alumni, they should be more attentive to their students whose goal is professional practice.

The committee report recommends offering "Career Opportunity" seminars. I would like to suggest another approach that might have the additional benefit of bringing the faculty into greater contact with alumni and other professionals. My impression is that in the units under review the graduate students and the more active undergraduate students are deeply involved in selecting, inviting, and hosting the speakers for the departmental weekly seminars. I know this is the case in Geological Sciences. Therefore, I suggest that the students take it upon themselves, perhaps with departmental encouragement, to invite one or two nonacademic professionals as speakers each Quarter. Potential candidates could be employer representatives interviewing on campus and alumni and other professionals working in the Seattle area, who could be asked to talk about an important case history or interesting project or job on which they have worked. The talks should be pitched at about the junior or senior level; and undergraduates as well as graduate students and faculty should be strongly urged to attend both the talks and the dinners afterward.

In this way potential employers would get to know personally the relevant students and faculty, students would make personal contacts and acquire a better knowledge of the professional opportunities and challenges in their field, and faculty would gain a better understanding of the goals and careers of many of their students.

Student advising. The committee report suggests "adding a nonacademic staff person (part-time or one person for both undergraduate and graduate advising)" in order to improve student advising. I believe that this idea needs further explication, inasmuch as it seems to imply that the nonacademic staff person would do all the advising, whereas that is not what I intended when I made the suggestion. Instead, I meant for the staff person to serve both the Undergraduate Advisor and the Graduate Advisor, who would be faculty members just as they are now, by maintaining student records, informing students about University, College, and Departmental requirements and deadlines, acquainting them with appropriate extra-departmental course opportunities, responding to requests for application forms and admission information, and assisting with the mechanics of the admission process. Individual faculty advisors would continue to provide counseling on matters requiring scientific expertise, such as course selection and professional opportunities.

Introductory courses. I agree with the recommendation that "Atmospheric Sciences ... should put outstanding teachers in the introductory sequence to attract more students." I am concerned, however, about the equity of such a policy, because it would reward poor teachers by systematically excusing them from teaching the most time-consuming courses. Perhaps the Department could follow the lead of Geological Sciences and use one of its FTEs to hire a knowledgeable, enthusiastic lecturer dedicated to teaching the introductory courses.

Graduate-student support. Although the ratio of RAs plus fellowships to TAs is considerably lower in Geological Sciences (0.7:1) than in Geophysics (11.0:1), Atmospheric Sciences (5.6:1), or Oceanography (8.7:1), all four units support virtually all their students. In all four units, however, the students were dissatisfied with the ratio. In Geological Sciences they wanted more RAs, because they wanted to spend less time teaching, in order to have more time for their thesis research; and in the other three units they wanted more TAs, because they wanted to spend more time teaching, in order to get the experience. The optimal ratio might be about the average ratio of time spent on thesis research to that spent on coursework and examinations (roughly 2:1).

In Geological Sciences simply increasing the number of RAs would damage the teaching program by reducing the number of students available for TAs. Achieving the optimal ratio without damage would instead require increasing the number of graduate students by 80% and the number of RAs 3-fold. In the other three units achieving it without damaging the research program would require smaller increases in graduate students but similar to much larger increases in TAs (40% and 6-fold in Geophysics; 30% and 3-fold in Atmospheric Sciences; 35% and 4-fold in Oceanography) and hence in enrollments, especially in the introductory courses. I believe that not only the graduate students but also the four units themselves and the University would benefit from an effort by the faculty to move closer to the optimal ratio of RAs and fellowships to TAs.

Required courses. The committee report suggests that Geological Sciences "consider one or more required courses in Geophysics as an ingredient of the major." I strongly question whether such a

requirement would be educationally sound. If implemented at the lower level it would entail removing the geophysical content currently integrated into the existing courses and teaching it separately as a new course. If implemented at the upper level it would, because of the limitation of a major to 90 credits maximum, necessarily displace a substantial part of the currently required 20 credits of elective 400-level Geological Sciences courses. These few electives are where students finally reach the professional level in their areas of geology or paleontology. They should not be displaced by what amounts to an upper-level breadth requirement.

The goal of this suggestion, I believe, is not in fact to improve the major but instead to get Geological Sciences and Geophysics faculty working together more closely. Given that Mathematics courses have for decades been required as an ingredient of the Geological Sciences major, I am skeptical.

To their credit, Geological Sciences and Geophysics currently cross-list seven upper-level courses, many of them taught jointly by faculty from both units. Other existing 400-level courses perhaps also could appropriately be cross-listed and jointly taught; and doubtless the two units could create additional new ones to add to the list. Jointly offering seminars, such as the one offered by QRC this spring on *Mountain Building and Climate Change,* and cross-listing and jointly teaching courses, particularly ones that students want to take, is in my opinion the most promising approach to strengthening faculty interaction between units.

Concluding remarks. I hope this letter may prove of some value in your further deliberations; and I apologize for any places where through lack of information or understanding I have been misguided.

I enjoyed serving on this committee and seeing in a single (if marathon!) view the full panorama of the geosciences at the University of Washington.

Very truly yours,

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