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Interview with Dr. George McRae (GM)

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by

Dan Finch (DF)

GM: So, a lot of the faculty members around the country, people with Ph.D.'s, computer science in general. Computer science didn't exist at that time. They all worked for government or industry in the space race. And, that's what happened here.

DF: Right.

GM: So, a number of Ph.D.'s in math had been also, I don't know the numbers, but also physics, chemistry and so forth, and math here. It seemed like nice, as an undergraduate 10 or 12 Ph.D.'s in the math department, and by the time I graduated three years later it was something like 4 or 5. And the rest had gone to work in Sylvania and all kinds of places, had really good opportunities in other schools. And it was really a huge, big push across the nation for space, science, really math and all that stuff started, and the National Science Foundation started pouring lots of money into graduate programs. So, that's partly it. So, I had a real nice fellowship while getting my master's degree. I was a TA. I had a National Science Foundation--they called a cooperative fellowship. Take (?) and I could take 15 credits.

DF: Yeah. I wondered you said you'd mentioned.

GM: Or a year, so I finished in three quarters. I was one or two credits shy of finishing at the end of spring. Starting in fall, finishing in the spring quarter the master's, but then I stayed on to teach here. And this, and I taught calculus and differential equations and also statistics. Howard Reinhardt was just new here, but he left to do post-doc work at the Army Research Center at the University of Wisconsin. He'd come here with a new Ph.D. from University of Michigan in Ann Arbor. He was gone for a year when I was teaching here. I had the course the previous year too, I took the courses from him, graduate and masters. Anyway, so one of my jobs is sort of fill-in. It didn't start out that way, I was actually going to you know, do something else when another person was hired with a Master's degree to fill in for him. That other person had left after the end of December.

DF: I thought you said first quarter?

GM: Yeah. Boeing or something, and he was in charge of teaching the year-long statistics courses. And so, I had to take over something I guess, and he also was the official (?) for the university. Craighead for example. . . Frank to all their studies. When Ray Tether (?), you know wildlife biologist and others, they were doing (?). . . Then Don Sward went to work for, I think he .I've forgotten what was. it has been back a while, but (?) I think he went to work for IBM. Other people went to work for Bell Labs. I mean all kinds of jobs, Sylvania, all kinds of jobs. Books (?), hardly any of them left here then, to go to other teaching jobs, although there was quite a bit of there too. So, some of us, so, Joe Hashisaki saw me; he was my master's thesis advisor. He left at the end of that year to become chairman at Western Washington, Bellingham. And he too quit. And Paul Reid who was in graduate algebra. I guess Western Washington was trying to become a 4 year with graduate, with Master's graduate program to have at the university. They've been a teacher's fellowship that Eastern Washington, Western Washington, all Central Washington, they were all in this teacher's club. They wanted a four year liberal arts and college with a master's level graduate program then in the basic areas. Biology, math... (?) So, some of the people from places like here had really nice offers to go places like that. So, there was a lot of mobility. Summer time, you could just get a job anywhere in teaching summer school in math. You didn't have to stay at your own institution, so I, my advice for here, after graduate work, one year of graduate work at the University of Washington. I spent; I taught at Western Washington, I was at Bellingham for the summer. But there were like three other people there that summer that were teaching from California, from back east, from all over. People have wanted to spend the summer you know, on the Puget Sound Basin. And it was just another holiday teaching those.

DF: Interesting.

GM: And it all sort of becomes a structure. There's tremendous design. Developing that in math and science. Everything about math and science in the cost of the work. And it's also the case that there weren't very many new Ph.D.'s being produced. When I started the graduate program at the University of Washington, in the fall of '62. And that year.. and I think

there was like 600 Ph.D.'s in math in this country. By the time I graduated, it had gone to 1200. It doubled. And all the graduate programs were just double during that time. And, but by the time I graduated, then it was, 1200-1300 Ph. D.'s that year, and they aren't all likely to get jobs. Jobs were becoming a pretty tight market at that point. But prior to that, it was still moderate. You had lots of choices. And if you had a Ph.D., up there, say teaching, you could get summer jobs working for NSTA or you could get summer jobs teaching some place. I think you could pick your geographical area. But then it's, the shorter, ever since, I graduated, the numbers, I haven't really paid too much attention. But they pretty much have stayed right there. But the other thing, that if you don't, the thing about Ph.D.'s in math that you have to factor in is the fact that we now have Ph.D.'s in computer science and in statistics and in specialty areas of math, numerical analysis, that were just, didn't exist. Computer science graduate program didn't exist. Operations research graduate programs didn't exist when I started my graduate work, but they started developing those. I mean, there were departments, computer science departments that existed, operation research departments didn't exist on college campuses for the most part, but all in the last 20-30 years, those have now become separate departments. And they have separate departments of statistics, or separate departments of numerical analysis, they also have separate departments of computer science. And they could produce their own, their own graduate program where they could produce their own Ph.D.'s, and so if you want to compare the Ph.D.'s in math, thirty years ago with the Ph.D.'s in math today, you need to factor in for that. In fact, thirty years ago people were getting Ph.D.'s and they were called Ph.D.'s in math, but in fact they were people that end up majoring in computer science now a days. So there's that, you have to look carefully or compare the wrong numbers. But in a certain sense, Ph.D.'s in sort of the mathematical sciences, has sort of stayed, in this country has sort of stayed at the 1000, 1500.

DF: Right.

GM: In that ballpark. The cross section of how many of them are foreign born has changed. You know, ten years ago, I would guess now, one, probably of four or a third of all of them are Chinese born graduate students. Even here at the University of Montana we have the same cross section of Chinese students as they have in the nation. And with changing of things in China, the Tiananmen Square-type things, that's changed as far as they come to this country.

DF: Right. So, you know you mentioned that when you came out, it was much harder to get a job, but you chose to take a position here?

GM: No, I went to the University of Illinois Champaign-Urbana from the University of Washington I went. But I had to; it was really my only job offer. Although I could have, I was recruited by the University of Montana, Montana State University, UVC, and for that matter Bellingham, but I had chosen not even to apply at those places, and they called me about jobs, and that's because I knew people at these places, but I deliberately wanted to try if I could get a job someplace else northwest because that was the only place that I had been. And then, of the places that I tried elsewhere, there were no jobs in the state of California.

Virtually identical, my advisor wanted me to go to, he had wrote to various places, and places, Berkeley, and Yale, and so-forth. But Berkeley, they wrote back and said mine was two positions.

DF: Oh wow.

GM: Available in the math department. And that was, and they blamed it on the governor at the time. The newly appointed governor Ronald Reagan.

DF: Ronald Reagan, yeah.

GM: That he was cutting back on graduate cutting back on research and graduate science and stuff like that.

DF: And how long did you stay in Illinois?

GM: Three years.

DF: Okay.

GM: And then I came back here.

DF: And you, you know when you were at Illinois, had, were you looking to get back at some point, or you know, then why did you choose the, being the faculty here?

GM: Oh, mostly because I, at the time I was coming back in the summers because my roots and my family and my wife's family were all Montana-types. And so I would come back for two weeks vacation in the summer to spend most of it on horseback in Bob Marshalls in Montana, fishing. But it took a day, you know, over a day to drive, so really a long ride to Montana. And we just went away. So, when you get this sort of reason like that we decided to come back to Montana. And I only considered coming back here, and there was a job available at that time. You know I liked Illinois very much and I've got some, lots of really good friends from that. It's a good place. Our kids were born there, but where that it's green as Seattle...Champaign-Urbana and Champaign-Urbana is a very nice place to live, to be at that point. But the disadvantage is, if you sort of like the outdoors, recreation, that sort, then there isn't much there. All the people there that were into skiing or anything like that, always, were transferred, gone, would go to Colorado. But there's some people that Champaign-Urbana that thought it was the west, of wide open spaces, the west. And they were the ones who grew up in Brooklyn. And so here, in the Champaign-Urbana I have the house where you see farm fields and cows.

DF: Right.

GM: It's a small place.

DF: That's true.

GM: So, it was very rural, rural-type town. So, anyhow I had no regrets coming back here. I enjoyed it. I like the size of The University of Montana. It, when I started as an undergraduate, there was like 3,000 students. Over half of them were Korean War veterans. So, most of them lived in married student housing. They were like strip houses at that time you didn't have fancy, it was, you know. But that had a big effect on just the student body to have the majority of the students being married, Korean War Veterans. My younger brother was going to Dartmouth at the very same time, and it was the same size school, they had 3,000 students, you know there were 2,700 students at Dartmouth. But they were all 18-22 years old, and they would have food riots in the mess hall, you know food service.

DF: Cafeterias. Sure.

GM: Cafeterias, but like those kinds of things in other context, but you'd never see a riot here. Just the mature, sort of the mature attitude of the average student was very much enhanced by these veterans. They were very serious students, they may not very good students in some cases because of their backgrounds, only they worked hard at it, were very serious about it. They didn't have a lot of this sort of panty raids or food riots that you read about on other campuses. They didn't, didn't have it, state universities in general, and certainly not here. But then it grew so that when I came back you know in '70, the enrollment was right at 10,000. I don't know, 8-9,000, something like that. See there was a decade there where it really grew because every university, University of Washington grew; the University of Illinois grew; all grew too. See, we were then, in Montana, and Montana was then like.. I came back of course when there were riots on campuses. It was the campus of hate, screaming and when I came back in the fall after the spring of Martin Luther King being killed, Robert Kennedy being killed, Penn State riots, the Vietnam War, there was a real problem for people in this country. And so there were sit-ins on this campus where the students were sitting-in on the ROTC headquarters. Sit-in on the President's office, wanting the president to do something of this or that. And that was, in Illinois in Champaign-Urbana; we had riots, where all the members (?) were broke down, and they returned a building on the quad, a huge big pretty square quad with these ancient old, colonial style buildings there, three and four story buildings. They had landscaped all their flower beds and the sort on campus, with washed rock about that size. So, when you have a few thousand students marching, protesting things, it was just natural.

DF: Like that's the one.

GM: They picked up those rocks and break every darn window in the quad.

DF: Wow.

GM: So, then they had to put sheets of plywood on all the windows, it was a temporary solution, but. And of course, what the physical plant did there was before they put glass back in those windows they went and picked up every one of those rocks and replaced them with

beauty back the same size. But it was, you see we had 30,000-40,000 students in one square mile, and you had extra things that you had to deal with.

DF: Certainly.

GM: Just because of that many people. Whereas, and so I thought coming back here to 10,000 is not that many students, that it's the right size for a university. Big enough to have resources, libraries, computers, and whatever, but yet small enough you would actually know people when you see them. At the math department at the University of Illinois we had 154 in math faculty, 200 supported graduate students in math, and another 200 unsupported graduate students in math. They worked at Motorola, places like that, while they took courses. So, it was a big operation, just the math department was a big operation.

DF: Sure.

GM: So, the joke was that the head of the math department didn't even know the names of the people in his department, 150-some to know. And he was challenged with that. And, but it turns out he actually knew the names of everybody, and their wives, and so forth, even though we couldn't have, see we never had faculty, department meetings, and never had department parties. Because if you have a department party where each person can bring somebody else, that's, there would have had to be room for 300. And in the years I was there, twice did we have such a party, and it was the state-rented the ballroom, the Illini Ballroom. Like I say, we never had department meetings, because they didn't have a big enough meeting room on campus to have 150 people sit down at a table and discuss motions.

DF: Right. Right.

GM: So, it was a different. And then the University of Washington was big also. There, and the student body was the same size, right at 40,000 as at Illinois, but the faculty of the math department, the faculty at Washington was one half the size of Illinois. We had 75 full-time faculty, and the student, the graduate student was about half, at about 100 supported graduate students. But the main difference between the two, and there was one way of accounting for that difference in size in teaching faculty, and that was the fact that the University of Illinois never had a single math class with more than 25 students. Whereas at the University of Washington, it wasn't until you got to be a junior, in junior-level math courses that you had class with less than 80 students. Most of our classes were taught to 500, at least hundreds at a time, freshman and sophomore classes. Whereas Illinois, they were able to get away with it. See, their, and one explanation was this was before the days of one man one vote. And in Illinois, in that the legislature was sort of run by the down-staters, you know down-staters were the farmers. And it wasn't run by Mayor Daily, of Chicago.

DF: He was in Chicago.

GM: And they liked what the University of Illinois, the other thing is the state of Illinois didn't have a Michigan, Michigan State, Illinois, you know where they had the A&M, agricultural, mechanical, engineering. at one campus, professional school at the other campus, they just had one university for the state of Illinois. At the University of Illinois they had the agricultural, and the engineering, and the law school, and the business school, and the pharmacy school, and everything in one university. And the Ag. School was really good at developing new hybrid corn, soy beans, and fertilizers. So that the, Illinois was very rich agricultural state, very productive rich agricultural state, and much to credit and opportunity of the University of Illinois Ag. School for making it that way. And so the down-state farmers in the legislature rewarded and supported the University of Illinois by funding them well, so they could afford. Math departments had a tradition saying that they couldn't teach math to more than 25 at a time, and so they made sure they had the faculty so well to do that. Whereas at the big state universities on the west coast or the big 10 in general, the Ohio State's, the Michigan's, the other states that didn't get to do that at the same time. So, at the same time we at Illinois had 20-25 at a time in our honors calculus there, and they stopped us there, and we only had to have 10 or a dozen, 15, but in my regular calculus, or differential equations whatever. I taught... I never had more than 25. But when I taught math at the University of Washington, I had hundreds. And at night school, we had a night school at the University of Washington, you could get a bachelor's degree in math, but just at night, then most cooperative, Boeing-types, and there I taught advanced calculus; that would be medium size classes. Anyway, I liked the size, and it was sort of family roots that brought me back as well as I like the size so I could know people in science departments or music departments. I could get to know other faculty instead of just like the ones that worked in the department.

DF: And, on, like a few, not even all of them would have been.

GM: Sure.

DF: Ok. Getting a little further behind that George, was there someone, or how did you, you know, how did you choose mathematics as a field? A lot of people have a, you know, an early teacher or something like that that, who influenced them, and how about yourself, you know, how did you come to choose mathematics?

GM: Well, I had a good experience with math in school. In grade school and in high school, and had older brothers that were going to college in the sciences, math and sciences. So, it's because of that, it was pretty natural for me to choose math as well as a major in college. But I had, so I had an (?) since I was a math and physics major; but I also had friends who went languages and did other language. And so forth, a scholarship and had to be a major. You know I had taken languages in high school, but at the price of other family members and others. And then, why did go immediately onto a graduate program, that's probably because of the times, and stuff like that times, posted up in times. It provided opportunities.

DF: Right.

GM: . that I took advantage of. And I had had interest quite in the past, coupled with the Cuban Missile Crisis, Urban Mall type times. And if you see, I, there was a draft at that time, and they would give you deferment from the draft, being a foot soldier by being a math teacher, so I was very distracted for the time I was teaching for a year going in. I only intended to teach that one year and then go on to graduate school, but in the middle of that year I had to have the Dean of the Arts and Sciences go down to my local draft in fact. I told them I shouldn't be drafted right in the middle of this quarter because of my college teaching position. Whereas they would give you deferment if you were a graduate student, they had student deferment, but being a teacher wasn't a good enough reason at my level of work.

DF: That's interesting.

GM: So, that was an incentive for me, if I didn't want to become a foot soldier, and you see, I didn't intend to be a foot soldier. My older brothers who had gone to college, they went into the military department. (Tape flips over). And so we still had the draft at the time, and my, in my own case my older brothers had been one of the ones in ROTC Program here. And the other was an officer in the Navy, but he had gone here and got a degree in pharmacy, and he could then. People in the medical field could get officer appointments with various branches, and my brother did so. Pharmacists didn't want to see, these were brothers that weren't married with families, but if you were married with families you got deference...

DF: Right.

GM: Regardless of what your occupation was, but the, so I knew that just because I didn't want to be an enlisted person, drafted, so I. If I were going to serve in the military, I much rather have served where I could use my scientific background and be more valuable to the nation that way, rather than just being another one the grunts. So, my, at that time my idea was to get a graduate, go on to a Ph.D. And so, that's what I went and did, and there I picked the schools mostly by the ones who saying they would give me a letter deferring me. So I could turn that over to the draft board and start this process of getting deferment for the next year. See, by getting people to go back for me, they said that I wouldn't have to put my uniform on until school was out, that I could finish the year teaching, and they shouldn't draft me. So, I crossed the table saying that I would have to put my uniform on the 15th of June when school was out. But, and then I did all the induction physical like going down and then get the deferment to go to graduate school the next year, by getting into graduate school, and I only applied to three of them, I got eventually got accepted and support from all of them, but I choose the University of Washington first. To give me everything I wanted. And then... [Knock at the door] Come in...

Guest: Hi, I was just going to turn in my dissertation (?).

GM: Thank you now.

Guest: Thank you.

GM: Yeah. So, I chose the University of Washington, I suppose, the main reason would probably be because of Merle Manis and Gloria Hewitt. Gloria, my first year of teaching here was her first teaching here, and she just came from the University of Washington. And Merle had gone to the University of Washington for one part of the year, the year that I, let's see, no, he and I got, he and I both got our master degree together here, and I stayed here. We both had NSF Fellowships, and so he went, he was a Korean War Veteran, so he didn't; he already put his time in. He had gone to school on the G.I. Bill, and, but he'd been after getting his Master's degree here, with me, we finished up together, he then went to the University of Washington.

DF: Sure.

GM: For his Ph.D. work. And I stayed here to teach. But he didn't finish the year out there. He got married and came back and taught the last half of the year here, and that was because like I say we had people here that started the year out, and they left for bigger and better jobs in industry too. And so there was openings in the middle of the year. He came back and he stayed on to teach for a couple more years, before he went back, and then he went to Oregon to get his Ph.D. So, that's sort of why I choose. Now at the same time I considered Wisconsin, and Berkeley. And Berkeley because that's where a whole bunch of my undergraduate classmates from here went. Keith Yale, Max Solberg, Brian Adams, and so they all went to Berkeley. And so, I'd been down there to visit them. And so I was interested in going there. And then Wisconsin was another natural because I had older brothers who had gone there in the sciences. Maybe not at that time, but I did have older brothers that got their degrees there, but I can't remember now. But probably the main reason, one of the main reasons that I considered Wisconsin was because R.H. Bing was a famous topologist there. I had an interest in topology. So, and he'd been here for a visiting lecture, and I visited with him and liked, and he intrigued me to go there. Like I say, I ended up mostly choosing the University of Washington over the others because they could give me a letter that would get me, keep me from going in as a foot soldier (?).

DF: Sounds like a good reason to me.

GM: So, and then after I was there I got married, of course. I never really had that problem. So, when I got my Ph.D. and went to work at the University of Illinois, at that time I had Lorene. She was 6 months or so old, so, and I was older then too. Being foot soldiers (?). So, that, because of my particular age, all of us at that particular age didn't have to serve. The war I would have served in would have been the Vietnam War. I was just a little old to not be really considered as a part of the draft. And then of course they changed all the draft went through a lot of revisions.

DF: You know, so since you started here, even as your undergraduate, you have a lot more exposure than most people do to the department, and obviously it's gone through many changes, but are there some kind of key transitions to the department, since you've been involved with it, George, you know that kind of stick out in your mind? And they can be

any kind of thing, they can be maybe a direction of the department, physical changes, or you know, like you'd mentioned before the computer science broke off and became its own, but you know.

GM: That happened, they actually, the computer science department was created almost 10 years between the time I left here and the time I came back. How? My guess is 8 years, 8 to 9 years. And so, but I actually kept in touch with the department because I knew most of the people that were in the department who are even not only in the department on the faculty, who at that time. Because I knew a lot of the people on the faculty because when I was, as an undergraduate I worked in the Registrar's office, I was assigned veterans advisor. That was my departmental job. And, as a consequence I knew lots and lots of the Korean War Veterans. And lots and lots of the faculty that I knew I had never even had courses with at the time, you know because I worked in the university's office and being around, and I was involved in some student-type things like that. The, and then I get, I myself was not in the student government, but classmates in the math department, you know most was, you know the president and vice-president people like that on the various student body officers were friends of mine. Like I say, two or three of them were math majors. So, because of those kinds of connections, you know, I really kept in touch with lots of them here. And so, that was fairly natural to kind of develop a computer science program, but in the math department to start with, that's how most of them started, and then when it got to be big enough that they formed their own department, with their own degrees, undergraduate and graduate degrees. And the other, but another feature that you know, physical feature about the math department here would be the fact that when I was an undergraduate, and including after when I first came back here in the early 70s, this was the Math/Physics Department. The lower half was physics and the upper half was math. And then, at some point in the early 70s, they built the science complex, that building and the math people moved out of this building over there, and then the, I mean the physics people moved out of this building and moved into the science complex along with geology and some of chemistry and some of forestry. And then the math department took over the rest of this building. And that's the way it's been. Now, of course it's outgrown this building, so now we have to, there's never enough office space, where we even had let our classrooms in this building. Now we have to have neighboring office space for all of math teaching faculty as well as math classes. Back when I was undergraduate when I first came back here, the astronomy courses were taught by math faculty and we've taught next door in the planetarium. But that's changed; they've made that into a sort of office-type building, even though it's still got the stars painted on the ceiling, fashioned that way for astronomy courses. But then the physics department has added astronomy as part of their curriculum. So they have faculty persons that teach astronomy courses.

DF: Right.

GM: The math department or mathematics curriculum courses keeps changing as it should. Changes in technology as well as changes in the application for more and more disciplines require more and more mathematics for their programs. And the math department does that service in part to teach more department math, so that's happened. So we teach freshman

level courses for different uses business math, math of the biological sciences, math of the social sciences. Different kinds of courses they've all developed over the years. When I came back to be, the math department had a grant to improve the graduate program in math here, by you know, improving the library facilities, improving the, adding more faculty lines. And changing, adding new courses, graduate type courses. And so, I came back at a time where new people were hired [interruption], and so that was a sort of big event in the history of the department. And that sort of coincided with the building of the science complex. I came back, and it was probably two years, I still only spent two years, I was in here, I don't remember what year the Physics department moved out of this building but it would be early 70s. I came back in 1974, and then about a few years, three years maybe the physics department moved out, but at the same time, and the same time we had tried to build up the math graduate offerings and so forth. And one of the new features was a sort of second option for a Ph.D. in math, we had option 1, option 2. One of the options was the traditional research oriented, and the other option was sort of a mathematical practitioner, teacher of mathematics college-level mathematics, interdisciplinary type of mathematics, a practitioner of mathematics, a general analogy with medical science, medical field have specialist, and then they have practitioners. And most graduate programs in math had evolved into producing new Ph.D.'s in these super specialized areas. And that really meant that the best kind of job for them would be another super specialized graduate program, whether you wanted to teach in a mostly undergraduate, 4-year degree program, you had to be, have a broader experience in college and graduate math. So you could work on interdisciplinary math things going to a small school, there would only be a handful of people in the math department, but they probably shared that department with other science people, so it's really a math and science type department, and so that was the idea. To design a program, Bob McKelvey, was the one that got the big grant to have that in that program. So, that influenced a lot of the courses we taught, we developed [bell rings] to meet the market. Those first Ph.D.'s that came out of here, then came out really at a time where it was really hard to get jobs. When I left, and I wanted to come back here in the next few years, there was a lot of people at the University of Illinois, really good research type Ph.D. weren't able to get tenure track jobs, teaching jobs, and whereas the people getting their doctorate degree from here that had this mathematical practitioner type background where they could step in and do undergraduate teaching with computing math, you know, interdisciplinary type things, they were all getting jobs, and that's not so for some of the others were in different programs. So that then, was a big problem in mathematical professions to, you know, shortage of jobs, a tight job market there for a few years. And, anyway that concludes that. In the history of the program as I've known it that would probably be an important part, that part of the, and it's still a part of the graduate Ph.D. program here, several recent people that's been their goal and taught over. Came here because of that with the idea of going back into the teaching at small liberal arts college as a math faculty there. So, that's been a fairly successful part of the overall history of the department I guess.

DF: You know when you think of the department itself, do you, was there some way by what we as a department, our assets have to offer. You know, not necessarily compared to anyone else, but what do you think distinguishes this department?

GM: Well... [Long pause]... I would say, well about the undergraduate program here has I think always been a good undergraduate program in math for both pure as well as the applied areas. And one way of measuring that is by the success of our students. They go here to get their undergraduate degrees and then they go on to graduate school, in the mathematical type sciences and do well there. As well as the ones that go on to, go to other industry with their mathematical, or a quantitative science, or at least background that they get in our program. So that I think has been a strength of the department and the credit for a lot of that probably has to go back to N.J. Lennes. He built a strong program here in pure math emphasis, you know then, but that's what math was, in the first half of the century anywhere in the country. Then for the graduate program, and then let's see I guess for the undergraduate program to me one of the things that's been distinctly ours, is the proper size. Small enough so they would be personable I suppose, yet big enough to have some resources, some quality resources. And I tend to think that that's sort of one of the important features of it. So, it's maintained that sort of smallness, even while we've grown, doubled, quadrupled our size, as an undergraduate from 3,000 to 12,000 total enrollment. It's still maintained some of those features, so students can get a very good, if they want, at least they can get a very good experience in math here. It had a faculty that is very giving and willing to help a student that needs a special reading course of (?). We have a faculty that is interested in working with the undergraduate students and mentoring them. So that, that's one of the (?) and of course, some of the bigger institutions, there's nothing real personal about them, the operation. An undergraduate student probably would really find it hard to do individualized undergraduate independent research projects. And we've had a lot of our students do that you see, so, a senior thesis, do undergraduate research projects and do well at it, and use that as a spring board to you know their professional future. (?) And that, some of that kind of stuff is harder to find, hard for the student, the undergraduate student to find those kinds of niches. At the bigger schools where the undergraduates, I mean they would never get to know some of the faculty, as undergraduates. So I think for the size of the school, the smallness of the school, but yet on having a tradition of quality education and wanting to you know, provide specialized experiences for undergraduates, that's, you know an important part of this. And I don't know that we're much better at that than other schools, but I do know that some schools, I just, various times I've gotten calls from, you know, people wanting to know about this or that aspect of our program. They are pretty impressed with watching. You know our undergraduate students have done for example with I think these REU, these Research Experience for Undergraduates, and we've had more than our share I think of good students over the years in the undergraduate program. Now, in the graduate program though I won't, many of the same things about it, so we've been able to. One of the roles that our undergraduate master's program has always served here, I can say the same thing for the undergraduate master's program out at say Bellingham is that it provides a place where the student can attend from a smaller, typically a smaller program with their undergraduate degree being in math, but it's not a good enough background to allow them to go directly into a major master's degree program around the country. They would just fall through the cracks, but here, we're small enough that we can tailor make the program to provide what they, a successful experience, they start in with a weak background, say in math and take courses here and do a good job on their thesis

project, and then go out and get a good job you know, job experience at least, you know and competitive, getting competitive jobs that... (Tape ends).

[This tape was quieter and hard to understand; (?)'s indicate lack of clarity in speaking.]