

Downsizing at Rochester: Mathematics Ph.D. Program Cut

On November 16, 1995, the mathematics faculty at the University of Rochester got what was probably the biggest shock of their professional lives. An hour before the university administration was to unveil a major restructuring plan, they learned their Ph.D. program would disappear, the department faculty would be reduced by half, and adjuncts and faculty from other departments would be called in to teach lower-level mathematics courses.

The whole university faculty knew that the institution faced serious financial problems and that the restructuring would entail cuts in graduate programs. But no one in the Mathematics Department was prepared for such a severe blow. "It was a great surprise, it came as a shock to learn, one hour before it was announced, that this was happening," says Samuel Gitler. Ironically, just eight years before, Gitler had been hired expressly to build up the department.

The plight of the Mathematics Department at the University of Rochester has been discussed avidly since the announcement of the cuts. The university administration and trustees have received over one hundred letters from math-

ematicians and scientists urging them to reconsider their decision. In December the AMS sent a fact-finding committee to the Rochester campus, and the committee has produced a report¹.

The AMS Council has passed a resolution, initially drafted after copious discussions within the Committee on the Profession, strongly urging the university to reconsider its decision. AMS President Cathleen S. Morawetz has appointed a task force, chaired by President-elect Arthur Jaffe, to work further on the issue. Despite all the pressure, the university administration has held its ground and shows no sign of changing its decision.

Today's tight job market together with shrinkage in university budgets have led some in the mathematical community to suggest scaling back on doctoral programs. So why the outcry when a Ph.D. program goes under? First of all, Rochester's Mathematics Department is quite

¹The report is available on e-MATH, at the URL <http://www.ams.org/committee/profession/rochester.html>.

distinguished—a number of internationally prominent algebraic topologists are on the faculty, and there is considerable strength in probability and analysis—and their students have fared reasonably well on the job market. Although many observers of university downsizing foresaw cuts in mathematics departments, few predicted that a department of Rochester's caliber would be hit.

But if Rochester is rather stronger than the average department in terms of research, it is similar to many departments in other ways, notably in having few programmatic linkages to other departments and in taking some heat over teaching, especially in calculus. These are two of the areas the university administration looked at in deciding to cut the Mathematics Department. What happened at Rochester could happen elsewhere. Says Ronald G. Douglas, a member of the AMS fact-finding committee and recently appointed provost of Texas A&M University, "This will catch the attention of deans, provosts, and presidents everywhere."

The Rochester Renaissance Plan

For the past couple of decades, the University of Rochester has faced financial troubles. In 1970 it was third only to Harvard and the University of Texas in the size of its endowment. Today it ranks twenty-fifth. From the late 1970s until the late 1980s, the university engaged in highly speculative investments in small-capital stocks and venture capital. In some years the strategy paid off spectacularly, and in others the university lost a lot of money. Around 1986 the university restructured its investments, and since then the endowment has stabilized. In the late 1980s and early 1990s, Rochester struggled with a new set of problems, this time stemming from a decline in tuition dollars collected per student. The administration that was in place at the time seems to have operated in crisis-management mode, and its attempts to juggle the yearly budget gaps wore down faculty morale and induced some to leave. In 1991 one of the deans attempted to terminate several graduate programs. The president disagreed, and, after faculty outcry, the program was quashed and the dean was fired.

Into this chaotic picture comes Thomas Jackson, hired as president of the University of Rochester in 1994. Together with provost Charles Phelps and vice provost and dean Richard Aslin, Jackson worked for a year and a half developing a plan to address the university's fiscal problems. They considered a wide range of options, such as eliminating all graduate programs and becoming an undergraduate institution or closing its engineering school. In the end they devised the Rochester Renaissance Plan, which

aims to improve undergraduate education and uphold Rochester's reputation as a research university with strength in science and engineering.

The centerpiece of the plan is a strategy to raise student quality and increase tuition revenue. The university aims to raise student quality by reducing future admissions by 20 percent; this should work at least in the short term, because the top 80 percent of the current class have higher SAT scores than the remaining 20 percent. But how can reducing the student body raise tuition revenue? At present much of the tuition money collected is redirected in the form of scholarships to students who pay only partial or no tuition. The university is gambling that, by emphasizing undergraduate education, it will heighten its image as an "elite" school and improve its ability to attract high-quality students who can pay full tuition. If this part of the plan fails, the university could be in worse shape than before. Despite the risk, many faculty, tired of years of financial uncertainty, are relieved to have someone firmly take the reins. "Their plan entails some risks, but boy, having somebody with a plan who understands the problem is such a huge step," says Thomas LeBlanc, chair of the Computer Science Department. "I don't know how we could have continued on the path that we were on."

The plan also calls for cuts of various sorts. Overall, the faculty will be trimmed by 10 percent. The administration opted for selective rather than across-the-board cuts. Four graduate programs—chemical engineering, comparative literature, linguistics, and mathematics—will be eliminated. In at least one way, mathematics suffers the most of the four: There are interdepartmental Ph.D. programs in which faculty from the first three areas can continue to participate, but there is nothing comparable for mathematics. In four other departments—earth and environmental science, history, mechanical engineering, and philosophy—the graduate programs will shrink, with reductions in faculty ranging from 12 percent to 33 percent.

Mathematics also sustains the deepest cut in faculty size: the reduction from 21 to 10 is the largest in terms both of number and percentage. All but one person in the Mathematics Department have tenure, and the university has pledged not to fire any tenured faculty. Given the present age distribution of the department, it could take twenty years to achieve the reduction. The administration has said that would be fine with them. "On the other hand, this is a five-year plan they've sold to the board of trustees," notes Mathematics Department member Douglas C. Ravenel. "And surely after five years there's going to be some kind of reckoning with the board." So it is clear that the administration is

Resolution Passed by the Council of the American Mathematical Society, January 9, 1996

The Council of the American Mathematical Society is deeply concerned over the University of Rochester's announced intention to severely downgrade its strong mathematics program by eliminating Ph.D. studies, shrinking the mathematics faculty "over time" by more than one half, and assigning the teaching of calculus to faculty in other departments and to non-tenured adjuncts.

This plan displays a lack of understanding of the nature of mathematics, its role as a core discipline among the sciences, and its place in a well-rounded education

The entire Rochester academic community is ill-served by such a strategy. Calculus students will be taught by instructors much less likely to have either the wide-ranging overview of mathematics or the involvement with the subject necessary for truly effective teaching. Nor will these instructors be likely to stay abreast of current evolution in the pedagogy and content of calculus.

The hiring of low-paid adjuncts with no long-term commitment to or from the institution will undermine educational quality. It could lead to an egregious violation of principles of non-exploitation enunciated in the January 1994 resolution adopted by the Council in the name of the Society, on "Supportive Practices and Ethics in the Employment of Young Mathematicians." Advanced undergraduates in mathematics and graduate students in other scientific disciplines will be deprived of the support that a mathematic graduate program provides to their studies. Faculty in quantitative disciplines will miss opportunities to consult and collaborate with their colleagues in mathematics. In the absence of excellence in mathematics, the attractiveness of Rochester as a first-rate research center in physical science, engineering, and economics will diminish.

On intellectual, educational and practical grounds, Rochester's intended treatment of mathematics is incompatible with its aspirations to national distinction as a research university emphasizing quality undergraduate education.

The Council strongly urges the University of Rochester's administration to reconsider its proposed course of action with regard to mathematics.

counting on people taking other positions or early retirement incentives.

A Research University without a Math Ph.D. Program?

The Mathematics Department was just as aware as any other of the seriousness of Rochester's financial problems and of the inevitability of painful cuts. And the department generally does not disagree with the major outlines of the Rochester Renaissance Plan. But it does disagree vehemently with the idea that Rochester can continue to be a research university with emphasis in science and engineering when it no longer has a Ph.D. program in mathematics. "I really think that this administration has no sense of what higher education and research are," says Gitler. "They are going to make Rochester a trade school, not a university." Says mathematics graduate student Nora Franzova, "This university cannot be called a research university anymore if it doesn't offer basic research in the purest field of research there is—mathematics."

Many of the letters protesting the cuts in the Mathematics Department reinforce this point. One of the most powerful letters came from physics Nobel Laureate Steven Weinberg. "I would not advise any prospective undergraduate or graduate student who wishes to concentrate on the physical sciences to go to a university that did not have a graduate program in mathematics," Weinberg writes to Jackson. "It seems to me extremely unwise to eliminate your program in an area like mathematics that stands at the intellectual center of a large part of modern science."

Paul Slattery, chair of the Department of Physics and Astronomy at Rochester, says he "very strongly supports" the Renaissance Plan, even though he is not comfortable with the cuts in the Mathematics Department. He points out that there is a Ph.D. program in mathematics at every university where the physics or chemistry program is ranked in the top half of the recent National Research Council (NRC) ranking of graduate programs. "That gives you a feeling that we would be strange outliers in the community of universities that have a strong focus in the physical sciences," he says. He notes that the lack of a doctoral program in mathematics could hinder his ability to hire good people in physics, particularly in theoretical areas.

The Rochester administration realizes that the lack of a graduate program in mathematics will make Rochester an anomaly among research universities, but they do not seem worried. Jackson points out that, unlike in the laboratory sciences, graduate students are not imperative to doing research in mathematics. "The research tends to be fairly lonely work by a faculty member, maybe with colleagues who are at the same speed," he says. "Our sense was, you can do a lot of distinguished research without the Ph.D. program." But without one, will Rochester be able to attract good mathematical researchers? "My own belief is that the market is thick enough that we can, in fact, get and keep people who have substantial research agendas," Jackson says. He notes that the university can provide incentives other than a Ph.D. program, such as research time and support for postdocs, although there is nothing written about this in the Renaissance Plan.

Linkages to Other Departments

While the Mathematics Department has garnered considerable support outside Rochester, support on campus is less definite. Slattery sees the cuts in the Mathematics Department as a weakness in an otherwise strong plan, and he says he and others on campus are quietly discussing possibilities for "evolutionary changes" to address this weakness. He feels he must take

this kind of discreet, nonconfrontational approach. "One of the reasons why there hasn't been a lot of public outcry [on the campus]," he explains, "is the feeling that we should support the president, because if this thing doesn't work in the aggregate, then we're really in trouble."

In addition, the administration has made it clear that the departments that support the plan will benefit. A letter from the administration to faculty explaining the plan put it this way: "We wish to make clear that, in the new college environment, resources will flow more generously to those departments which succeed best in supporting the overall goals of the Renaissance Plan." Such statements could discourage supporters of the Mathematics Department from speaking out. But could it also be that the Mathematics Department has few supporters on campus? To hear the administration tell it, intellectual linkages with other departments were scarce. "As much as we tried to explore, we actually found very few present interactions that were taking place," says Jackson. "That is, it might be good in theory, but it wasn't taking place in reality."

The administration has said that one of its reasons for choosing to cut the Mathematics Department was that it had very few interactions with other departments. The question of how much interaction there has been is a matter of some dispute. The Mathematics Department has collected a number of examples of joint research between its faculty and faculty in other departments. The topics range from ultrasonic medical imaging to cryptography. In addition, students and faculty from other departments regularly attend graduate classes in the Mathematics Department.

By contrast, the picture painted by the administration is one of an isolated Mathematics Department. As part of the formulation of the Renaissance Plan, Aslin and Phelps conducted interviews with seventy-five faculty—three members from each of the twenty-seven departments on campus (in a couple of departments, fewer than three faculty were interviewed—one of these was the Mathematics Department). Aslin says they asked science and engineering faculty specifically about linkages to the Mathematics Department. "To be quite frank, we found very few," says Aslin. The issue seems to be that the interactions were ad hoc—a single research project or a specific course rather than an institutionalized program with high visibility. The interactions "were faculty A with faculty B because they had taken the initiative to form some sort of intellectual link," he explains. "But they were not nearly as robust as the kinds of interactions we saw between other departments outside of mathematics." And, Aslin claims, this was not be-

cause other departments have no interest in mathematics. "It turns out that they have sought those linkages external to the University of Rochester."

Others reinforce this view and take it one step further. "There is a large mathematical intellectual community on campus, and it goes well beyond the Mathematics Department," says computer science chair LeBlanc. He says there are a number of faculty in the engineering school who could "double as applied mathematicians" and some people in his department and in the Physics Department who are interested in certain areas of mathematics. Centrality of the discipline was one of the things the administration looked at in deciding which graduate programs to cut. "One can make the abstract argument that mathematics is central," he says. "But if you go to twenty-seven departments and every one of them tells you, 'The math department is not central to our program,' then although the abstract argument of centrality of mathematics is a good argument intellectually, if the reality is different, it makes perfect sense to view that as the basis for a decision."

Contention over Calculus Teaching

Another element that entered into the administration's decision to center cuts in the Mathematics Department was their perception that in mathematics "undergraduate instruction is less than optimal." Aslin says his interviews with faculty revealed that some departments were dissatisfied with mathematics instruction, particularly in calculus. In addition, there were anecdotal reports from the Center for Academic Support, which provides tutoring and other services, that students were having trouble with mathematics. Although he admits that some of the students' difficulties stem from underpreparation, Aslin believes that the Mathematics Department has not stepped up to address the problems. "What you look for is initiative on the part of the department...to begin to address what are in some sense nationwide educational concerns that go beyond the problems that are local at our particular institution," he says. "And I think we have not seen [that] kind of interest on the part of the faculty here in our Mathematics Department."

For its part, the department contends it has heard few specific complaints about its teaching. A report prepared by the department presents data from student evaluations showing that students are just as satisfied, and in some cases more satisfied, with courses in their department as they are with courses in other departments. And mathematics has made some attempts to reach out to other departments on the issue of calculus teaching. For example, two

years after he was appointed chair, Gitler conducted meetings with all the science departments to talk about what their students needed from mathematics courses. Recalls Gitler, "We talked and talked...and then when I said, 'okay, now it's time for you to put it in writing,' nobody sent anything in writing."

Three years ago, before Jackson came to Rochester, a task force on calculus was formed. The task force brought together representatives from different departments to discuss what they needed from calculus courses and what changes could be made. "My understanding is that the meetings were not successful," says Jackson. "I'm not going to blame anybody on this, but they were ships passing in the night. The math department's view of what the science departments should want, and the science departments' view of what they wanted—they weren't talking the same language."

The Mathematics Department does not disagree that little came out of the task force. According to Mathematics Department chair Joseph Neisendorfer, "The people in the biology and chemistry departments didn't think it was worth their while to participate; they were content with the situation as it was." At that time, the undergraduate degree in computer science was housed in the Mathematics Department (in 1994 it was moved to the Computer Science Department), so computer science did not express much interest in calculus. "The only complaints that I have ever heard came from mechanical engineering, and at one time from some people in physics," Neisendorfer says. And the complaints from physics have now disappeared: in cooperation with the physics faculty, Neisendorfer helped to structure a pair of courses in calculus and introductory physics that would run in close coordination. The arrangement seems to be working well. Some departments also complained that mathematical homework was not graded. The Mathematics Department does not have sufficient staff to grade all homework, but two mathematics faculty are now developing a computer program that will provide students with feedback on their homework.

The problems with mechanical engineering were not so easy to resolve. Five years ago, the Mechanical Engineering Department, dissatisfied with the instruction its students were getting in mathematics, began teaching second-year calculus courses of its own. Clearly this has led to some friction between the two departments. Some on the mathematics faculty believe that declining enrollments in mechanical engineering prompted that department to add more courses to keep their faculty busy. But mechanical engineering chair John C. Lambropoulos says his department began the courses

because the preparation their students were getting in the Mathematics Department was "not adequate", and they wanted to introduce more engineering applications and material specific to later courses. There has also been talk of establishing an applied mathematics department on campus, although under the current budget constraints it seems unlikely this would happen anytime soon.

The criticism the Rochester Mathematics Department has taken about its undergraduate instruction seems to be pretty similar to that endured by many other mathematics departments. But far from proving that there was no problem with mathematics instruction at Rochester, some observers say, this simply shows that many mathematics departments have not been responsive to problems (or at least perceived problems) with the instruction they provide. Nevertheless, many believe the Rochester administration dealt with this the wrong way. Salah Baouendi of the University of California, San Diego, who chaired the AMS fact-finding committee that visited Rochester, puts it this way. "Even if there are problems between departments—and it is not unusual to have different points of view—it is certainly wrong for the administration to take a core discipline such as mathematics...and eliminate its graduate program," he declares. "There are other ways to solve these problems."

In fact, the central question many have been asking is: Will the measures taken by the administration improve undergraduate teaching of mathematics? Many think not. In just a few minutes' conversation, Franzova and her fellow mathematics graduate student Lisa Christman exhibited a great deal of dedication to and enthusiasm for teaching. The department will soon lose such students. Christman, a second-year student, is not sure she'll be back in the fall, and she reports that twelve to fifteen of the department's thirty-four students will be gone by the end of the academic year. Most of the first-year students are leaving. This means that already this fall the university will have to arrange new ways to staff its lower-level mathematics courses.

The administration's plan to hire adjuncts to cover lower-level teaching in the Mathematics Department has elicited wincing from the mathematics community. In a letter to the Rochester administration, Alan Schoenfeld of the University of California, Berkeley, wrote, "I'll be blunt in summary: such instruction is typically cheap, and you get what you pay for." A major commitment is needed to make appropriate use of such staff, he argues. In addition, the best faculty will leave, and those that remain will have second-class status because of the lack of a graduate program and because their teaching will be

farmed out to adjuncts. “[T]he changes you propose are almost certain to produce a significant lowering of the quality of instruction in mathematics courses—no matter how you staff these courses,” he writes. “This is the direct opposite of what you intend.”

Decision Process Criticized

Throughout the formulation of the Rochester Renaissance Plan, the administration held its cards close to its chest. While they could not very well call a faculty vote on which graduate programs to cut, some say the administration could have been more open. Neisendorfer says that two weeks before the announcement of the plan, he spoke with the dean of graduate studies, who said there would be some cuts, but nothing drastic. It appears that only Aslin, Jackson, and Phelps knew anything about the details of the plan.

There have been complaints about the criteria the administration used to decide which programs to cut. The “internal” information they used came primarily from the seventy-five interviews with faculty. For “external” information, they relied on the NRC rankings of graduate programs and, to a lesser extent, the rankings published yearly in *U.S. News and World Report*. The administration has been heavily criticized for using these rankings as the basis for such decisions. In fact, one of the people who wrote to the administration to protest the cuts in the Mathematics Department was Marvin L. Goldberger, dean of the Division of Natural Sciences at the University of San Diego and cochair of the NRC committee that produced the rankings.

Many universities obtain external information about their departments through outside site-visit teams. Asked about this suggestion, Aslin contends that it would have taken three to five years to conduct such evaluations of all twenty-seven departments at Rochester. Couldn’t one bring in an outside team to evaluate just those departments that appeared questionable? “The problem is,” says Jackson, “that if you ask a discipline to come in and evaluate a program that’s already been identified as targeted, the response you’re almost certainly going to get from the people in the discipline is a case as to why you shouldn’t touch the program.”

Morton Lowengrub is not convinced. A member of the AMS fact-finding committee, Lowengrub is dean of arts and sciences at Indiana University. “How do they know they couldn’t trust the information” from an outside committee? he asks. As a university administrator who has had to deal with downsizing on his own campus, Lowengrub has used outside evaluations a great deal. “If you set the parameters correctly and you get respectable people, you get very good in-

formation that puts into perspective the department’s role in the discipline,” he argues. In fact, Lowengrub expresses great dismay at the entire process the university used to arrive at its decision. “They did not carry on a dialogue with the Mathematics Department; they never gave them a chance to respond,” he says. “This is one of the saddest parts of the whole process.”

Politics Comes to the Fore

As protests against the cuts in the Mathematics Department have mounted, the Rochester administration has endlessly explained and justified its decision. But some, far from being reassured that the basis for the decision was reasonable, have concluded that politics was at work. “My impression, the more and more I look at it, is that they felt mathematics as a group would not be able to respond to this,” says Gitler. “More and more I am convinced that it was a political decision and definitely not an academic solution.” Many in the Mathematics Department share his view.

According to Ronald Douglas the fact that the cuts in the graduate programs were spread around—some in the social sciences, some in the humanities, some in the sciences, and some in engineering—points to a political decision. Furthermore, “some of the rhetoric was clearly such that they knew what they wanted to prove and then went back and got the information they needed to support it.” After visiting the campus as a member of the fact-finding committee and reading the various documents associated with the plan, Douglas has come up with a theory of what happened that is roughly the following.

The administration had to cut a department in the sciences, so the question was which one. It made no sense to cut biology and chemistry, because the faculty numbers are critical to staff the laboratory-based courses taken by the many pre-med students. The Physics and Astronomy Department was already facing a cut in its faculty related to the shutdown of one of its facilities funded by the National Science Foundation. Moreover, substantial outside support in biology, chemistry, and physics depended on maintaining faculty size in these disciplines. (The Mathematics Department has done very well in attracting outside support: nearly two thirds of its members have grants. However, the total dollar amount is much smaller than in other disciplines.) Earth and environmental science is such a small department that even wiping it out would not save enough money. This meant that a cut to the Mathematics Department was inescapable. Once the administration concluded this, Douglas suggests, they felt they could solve two problems at once. They could produce the necessary dollar amount of sav-

ings, and they could take steps that they felt would address the instruction problems in mathematics.

Douglas believes that the only way the administration would reverse its decision is if they were somehow convinced that the cuts in the Mathematics Department might threaten the centerpiece of the Rochester Renaissance Plan: raising student quality and increasing tuition revenue. He is not sure that part of the plan will work in any case, because in the Northeast competition for high-quality students has been "heating up immensely." "They are banking on making Rochester a hot place for undergraduates, but I'm skeptical they will succeed," he says.

Some in the Mathematics Department believe that the termination of the graduate program could harm the university's attractiveness to undergraduates. "Rochester's main selling point for attracting students is that it has a small student body and small classes, so you can get a good undergraduate education," says Ravenel. "At the same time, it is a research university, so

as an undergraduate you have the opportunity to get some taste of what research is like... In the long run, the absence of a mathematics graduate program will, I believe, affect the intellectual tone of the university, and it will affect the university's ability to attract and recruit faculty and students in related areas."

For now, the Mathematics Department at Rochester has to live with the administration's decision. The AMS is doing what it can to help. The AMS task force on Rochester will continue to monitor the situation and provide assistance where possible. In addition, the AMS Task Force on Excellence in Mathematical Scholarship has already been looking at these kinds of issues for about a year now, and their report could help other departments avoid a fate like Rochester's. Perhaps all of the attention will help the department, but for now it seems still to be reeling from the blow.

—Allyn Jackson