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A History of the Department of Mathematics at the University of Pittsburgh, 1787-1995

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(Communicated by Lark Song)

Did you know that from 1978 to 1989, arguably the most distinguished mathematical statistician in the world at the time was a faculty member in the Pitt math department? Did you know that in 1849, the Pittsburgh Gazette made room on its first page for a written debate between two Pitt Professors, one a mathematician and one a historian, about the future of the university, pushing reports on a sensational murder trial then underway to the back pages? Did you know that in 1909 there were only three Pitt faculty members teaching math, one of whom was a Protestant minister with no college degree? And did you know that in 1994-95, four versions of math 0220 (first term calculus), were offered, with one of these taught entirely in a computer lab and another making no use of technology?[i]

When I arrived at Pitt in 1987 as the new chairman of the Department of Mathematics and Statistics, I found a department with over 40 tenure stream faculty and two instructors, including strong teachers and researchers, which was primed for further advances in both teaching and research.

In teaching, perhaps the most conspicuous change in the next few years was a sharp decrease in calculus class sizes, from up to 300 in my early years to 75 or under in the mid-90s. The number of math majors fluctuated over my time and after. I believe that there were under 100 majors in the department in my first year, most of whom chose either ("pure") Math, Applied Math, or Statistics, though there were also three joint degrees: Math and Economics, Math and Computer Science, and Math and Philosophy. Now the department has about 220 majors or joint majors, some in programs not dreamed of in 1995.

The department was also active in research by 1987. Statistics and mathematics formed one department then, and among the statisticians was University Professor C. R. Rao, a Fellow of the Royal Society of England, member of the National Academy of Sciences and over 30 other national academies, and in 2002, winner of the National Medal of Science Award.

Andrew Mellon Professor of Mathematics Werner Rheinboldt was also known internationally, for his research in numerical analysis and scientific computing. He was President of the Society of Industrial and Applied Mathematics (SIAM), the world's largest scientific society devoted to applied mathematics, and he led a strong research group in numerical analysis at Pitt.

University Professor Pesi Masani was a distinguished scholar in the areas of functional and harmonic analysis. He was the last person in the department to be subject to mandatory retirement, at age 70 in 1989. He continued to work in his office until one sad night in 1999 when a janitor found him slumped over his keyboard.

Professor J. Bryce McLeod, previously at Oxford University in England, and later a University Professor at Pitt and Fellow of the Royal Society of England, began his 20 year stay at Pitt in the same fall term as I did. He headed an active group of researchers in differential equations, collaborating with many from Pitt and around the world.

There was also a relatively young mathematical biologist, G. Bard Ermentrout, recently arrived from a Post Doc at the National Institutes of Health. He is now a University Professor, leading a well known group studying applications of math to biology.

In addition to Professor Rao and those who worked most directly with him, there were others doing good research in statistics.[ii] In mathematics we had research groups in analysis and topology, and individual faculty members active in other fields, including differential equations, combinatorics, and mathematical physics. It was a lively research environment.

Early Years

All this was a far cry from only a few decades earlier. As far as I have been able to determine, the first published research paper written by a mathematician while working at Pitt did not appear until the 1950s.[iii] This was about 20 years after faculty at the University of Pennsylvania became active in research, and about 75 years after significant mathematical research began in the United States. To see some of the reasons for this, we can start back in the 18th century and look at the beginnings of the University.

The founders were a group of prominent citizens of Pittsburgh, then a western outpost of the original 13 states. A number these men, as all the founders were, had graduated from the College of New Jersey at Princeton. One, Hugh Henry Brackenridge, became a Pittsburgh representative in the Pennsylvania State Assembly. From this position he was able to lobby for a State Charter of the "Pittsburgh Academy" of higher education. [1] This was granted in February of 1787, which is now taken as the official founding date of the University of Pittsburgh.

But one cannot build a university with only a Charter. Money is needed to acquire classrooms and hire faculty. Brackenridge managed to get the State of Pennsylvania to deed to the University 5000 acres of land, with the idea that it would be sold to obtain funds to get started. Unfortunately, for reasons which are fuzzy in my sources [1; 2], by 1800 the land had been broken up and sold for practically nothing.

Brackenridge's idea seems to have been that the State should support two Universities of comparable stature, one in the west and Ben Franklin's University of Pennsylvania (Penn) , in the east. The name of the Pittsburgh Institution soon became the Western University of Pennsylvania. But in 1800, the Western University was located in a remote city of probably fewer than 2000 people,[iv] while Philadelphia's population was over 25,000.[v] The State did make occasional grants for building projects, but without more state aid, which institution had the money to hire the better trained faculty? Which city was more attractive to leading academics of the day? In later years, which could afford to bring distinguished scholars from Europe? To this day, I have heard no rumors that Penn is about to add "Eastern" to its name!

In 1908, the Western University of Pennsylvania became the University of Pittsburgh, indicating that Brackenridge's goal of Eastern and Western Universities of Pennsylvania was dropped. In addition Pittsburgh was now a major city, deserving its own university.[vi]

I'll have more to say later about why Pitt was slow to undertake research in mathematics, but for now, what do we know about its teaching in the early days? Precious little. The first known written record of the curriculum, [1], reports that "the Learned Languages, English, and Mathematicks" were the subjects offered in 1789.[vii] Soon after, "Natural, Civil, and Ecclesiastical History, Logic, Moral Philosophy, and Chronology" were added, indicating a strong affinity for what was being taught in Scottish Universities at the time.[viii]

Pittsburgh Academy had, at the beginning, a faculty of five, all Protestant ministers. One of these taught "Natural Philosophy, Chemistry, Mathematics, &c. . . ." [1]. Unfortunately I have not been able to determine what material in mathematics was offered then, or any time before 1861. Two fires, in 1845 and 1849, destroyed pretty much everything, including most of the University records, and closed the University down for almost a decade.[ix] The first available Western University of Pennsylvania Catalogue is from 1861-62, and I will discuss its math offerings below. First, however, I want to say more about the 1849 debate referred to in my opening paragraph.

The topic of this debate mirrors a dispute in academia which continues to this day, and one of the participants was the Professor of Mathematics and Natural Philosophy. The other was a Professor of History, Rhetoric, and Belle Lettres (Literature regarded as fine art).

Pitt today, like most universities, has a school of "Arts and Sciences" and a School of Engineering. But engineering barely existed as an academic discipline in 1849. The subject of the debate was a proposal by the math and science professor to establish at Pitt a four year degree program in engineering. He said, for example,

"We must adapt the University to the needs of the community if we expect the people to support it . . . For the success of industry it is indispensable that the barrier between the artisan and the man of science be broken down."

And his rival replied, in part,

"It would not be just to tax all the people for an educational program for mechanics." .... "You would substitute the powers and laws of gasses and imponderable agents for the mind and heart."[x]

I haven't found any mention of who was thought to have "won" this debate, and the 1849 fire mentioned above occurred a few months later. No further movement towards an Engineering school was possible until after the Civil War, and for that story see [3], from which the quotes above were taken.

Now shift forward more than 150 years, to the early 2000s. A proposal has arisen to add a new major in the Pitt math department, Actuarial Mathematics. This is approved within the department and sent to the Arts and Sciences Undergraduate Committee, whose members come from a variety of departments. There, the reception is lukewarm, with some seeming to think it is too career focused for arts and sciences. The proposal is passed on without a recommendation, to a committee chaired by the Dean. Further discussion ensues, during the Dean says "How am I going to explain to the trustees that we rejected a major because it might help a student get a job?"[xi]

As the reader will probably know, the major was approved and is one of our offerings today, with a healthy number of students enrolled. Has the basic difference of opinion about the appropriate goals of a University been resolved? Perhaps a debate that has gone on for at least 150 years in this city will linger a bit longer.

I now continue with the Western University of Pennsylvania's catalog of 1861-62. There we find a single Professor of Mathematics, George H. Christy M.A.[xii] In those years every student took the same set of courses. The course of study over the four years included the following mathematics: Freshman: Robinson's Algebra,[xiii] Legendre's geometry, Sophomore: Davies Trigonometry (Plane and Spherical), Davies Surveying and Navigation, Davies Analytic Geometry, Junior: Davies Differential and Integral Calculus, Senior: None (!)

To see how this compared with offerings at other Universities of the time, I looked at the Penn catalog for the same year (the first year of the Civil War). Penn also had a single Professor of Mathematics, and all students in the arts (= arts and sciences for us) took the same courses. The curriculum was much the same as Pitt's, though only differential calculus was taught to juniors, integral calculus coming in the senior year. Juniors had an additional math course called "analytical mechanics", which was basically introductory mathematical physics and was first introduced at Pitt in the engineering school, which got underway after the Civil War.

A few years later, the idea that all students should study the same subjects began to fade, at both Pitt and Penn. By 1867 Pitt allowed students to drop Latin, Greek, and mathematics (!) after the Freshman year, and substitute an equivalent amount of English language and literature, metaphysics, chemistry, engineering, and modern languages. At Penn around the same time, no choice of subjects was offered to students until the Junior year.

Research in the Twentieth Century

I will now discuss the research aspect of Pitt math. Jump ahead to the 1909-1910 catalog, a year after the Western University of Pennsylvania became the University of Pittsburgh. In doing so, I skip the beginning of mathematical research in the US, but that history is not my task. I am following the development of mathematics at a small university in a large but geographically isolated city where steel was king. The relevance of mathematics to making steel was not apparent to the giants of industry at the time.

It was also not apparent in the halls of the Western University of Pennsylvania. Engineering was prominent, and Chemistry, of obvious importance in making steel, was the favored topic among the sciences.[xiv] In 1927, at least three of the four Professors of Chemistry were publishing their research regularly. Also, in those years a large percentage of the Ph.D.s awarded by the University were in chemistry. Yet as far as I know, no Pitt math professor would publish a research paper until 1951.

In seeking the cause of Pitt's lack of interest in research in math, it may be worthwhile to look at the Board of Trustees back in 1909. Among its 27 members were Andrew Carnegie, Robert Pitcairn (a buddy of Carnegie from their early days as telegram deliverers), Benjamin Thaw and his brother Josiah Copley Thaw, founders of a Coke company later sold to Carnegie partner Henry Frick, and William Scaife, who owned an iron company.[xv]

Overall, the Pitt Board in 1909 included six people in steel related business and one in aluminum. I believe that these were men who considered mathematics only as a subject to be taught to engineers and scientists. There were also five lawyers, six people in medicine or dentistry, two railroad investors, and single representatives of a variety of other fields.[xvi]

It wasn't feasible for me to test the effect of Boards of Trustees on mathematical research widely, but I did look at the Penn Board in the same year considered above, 1909. Out of 23 men (and like the Pitt Board, no women), the closest to an "industrialist" was a railroad executive who had been a surveyor. I was able to characterize the field of interest of all but one of those on the Penn Board, and there was no block comparable to the steel related group at Pitt.[xvii]

Returning to the 1909-1910 Pitt catalogue we find a list of all faculty members, and a quick glance reveals that most of them held MDs or other professional degrees. In those days the Medical School was the dominant part of the university, and the Dental school was also prominent. There were only about 100 students in the College, another 100 in engineering and a smaller number in the School of Mines.[xviii] As mentioned earlier (first paragraph), there were only three math faculty in 1909. One also taught Physics and was acting Dean of both the College and the School of Engineering. Another had an undergraduate civil engineering degree. The third had no degree at all, and I find him to be the most interesting of the three.

His name was Alan Spencer Hawkesworth, and in 1909 he was the only mathematician teaching in the Graduate School, as a "special lecturer". He was probably the first Pitt faculty member to publish in a mathematics journal we would recognize, with three articles in the American Mathematical Monthly.[xix] And he surely was the only Pitt faculty member who, according to Time Magazine in 1936, was "by profession a Protestant Episcopal clergyman, has served as mathematician in the Navy Department's Bureau of Ordnance, has lectured on philosophy, discovered some 100 new theorems in geometrical conics, become a cuneiform expert, passed through four South American revolutions and has seen "heavy fighting in the West Indies and China Seas."[xx]

The first step in developing a research program was to teach graduate level courses. Discounting Hawkesworth, this began in the Pitt math department around 1925, when finally there were qualified faculty, with Ph.D.s in math from good universities. One of these was James Sturdevant Taylor, whose 1917 Ph.D. thesis from the University of California at Berkeley had been published in the Annals of Mathematics,[xxi] well before he arrived at Pitt. Taylor would publish no other research, but he oversaw the development of research in the department, serving as chairman from 1941 to 1961. He had at least two Ph.D. students and 56 "mathematical descendents". [4] Other Professors in 1925 had Ph.D.s from Cornell and Ohio State. The faculty may not have been producing research, but they were in touch with what coursework was needed to train research mathematicians and college faculty.

The department's first Ph.D. was awarded in 1927, to Montgomery Culver, well known in the department today for the Culver Prize, an annual undergraduate award. He had been on the faculty, even teaching group theory, before receiving his degree in this area. He then taught in the department into the 1950s.[xxii]

The second Pitt math Ph.D. was awarded to Jacob den Hartog, a Dutch immigrant who came to Pittsburgh as a young man in the 1920's to work at Westinghouse.[xxiii] There he attracted the notice of Stephen Timoshenko, a famous name in engineering mechanics. Den Hartog specialized in mechanical vibrations and became known at Westinghouse when he was able to correct several instances of out-of-control vibrations in mechanical devices. He entered Pitt's graduate school, seeking a Ph.D. in math and doing the work for this in the evening, while still working at Westinghouse. He received his degree in 1929, with his advisor being Timoshenko, who had a Pitt appointment as "Westinghouse Lecturer in Mechanical Engineering". After getting his doctorate, Den Hartog taught some Pitt math department courses at Westinghouse for a year or two and was then hired in mechanical engineering by Harvard. He had already published at least 11 papers, 3 of them based on his thesis. He got tenure in 1936. When WW II started he entered the Navy as a Commander and put his skills to use in ship design and construction. After the War he moved to MIT, where he had a distinguished career in both teaching and research. He was a member of both the National Academy of Engineers and the National Academy of Sciences. As far as I know, he is the most distinguished graduate to date of the Pitt math department.

At Penn, mathematics became a separate department before 1900, with an endowed Chair, but as far as I can tell, the early department chairmen and holders of the Chair only published research in astronomy. Penn faculty had published some research in math (as opposed to astronomy) by around 1930, but the department there took a big step forward in 1934, when they followed the top American universities at the time by hiring from abroad. A German mathematician, Hans Rademacher, was hired as an assistant professor, though he had been a full professor in Germany. [5] He was eventually promoted, and did notable research, but even his influence did not begin to really pay off until the 1950s. [6]

As far as I can tell, the first European hired at Pitt was Enrico Bompiani, who was listed as a Full Professor in our catalogs starting in 1949. Bompiani was well known. From 1950 to 1954 he served as Secretary of the International Mathematical Union, which awards math's most famous prize, the Fields Medal, at its quadrennial meetings. He appears continuously in the Pitt catalogue until 1961, and in 1959 became the first Andrew Mellon Professor of Mathematics, but throughout this time he also had positions in Italy, serving as President of the Italian Mathematical Union. I have not been able to find any publication where he lists his affiliation as the University of Pittsburgh. His teaching record at Pitt is also scanty, since most of the catalogs during the time he was here either do not associate him with a course or list him with a course which was not being offered in that year. However he did graduate a Ph.D. student from Pitt, Earle Myers, who was then a faculty member here for many years.

Also, it appears likely that Bompiani attracted another Italian mathematician, who did publish in top US journals, listing Pitt as his university affiliation. His name was Iacopo Barsotti, and he became prominent enough to earn an entry in a well know collection of mathematical biographies [7]. Barsotti, who started here as Associate Professor but soon was promoted to Full, taught every year from 1951 to his departure in 1960, covering a wide variety of courses. He left for Brown University, but in his first year there he applied for, and obtained, the chair of geometry and algebra at the University of Pisa. He took up that position the next year and some years later moved to Padua for the rest of his career. I believe that Iacopo Barsotti deserves to be called the first mathematician at Pitt to produce significant research while he was here.[xxiv] And James Sturdevant Taylor deserves credit for hiring him.

By 1960 America had been producing its own research mathematicians for at least 70 years. In the 1960s Pitt hired additional active researchers. Some of these were trained in the US but the most distinguished of them was from Japan. Jun-Iti Nagata, a world leader in general topology, was here from 1965 to 1975. Perhaps because of him, general topology remained the dominant pure math research topic at Pitt into the 80s.

Research in many disciplines started to take off at Pitt in the 60s. Why? Taylor could not hire anyone without approval from the higher administration. In 1956, Pitt hired as Chancellor Edward Litchfield, who had grand ideas for boosting the quality and reputation of the University. With Trustee support he began to recruit new faculty from the best institutions of the time. This wasn't possible for the whole University at once, but he found targets of opportunity in Philosophy and Anthropology. He succeeded in turning the Pitt philosophy department into a national leader, as it remains today, and Anthropology also developed an excellent research program. Then the money ran out.

This story is far too complicated to discuss here in any detail. See [2]. In the mid 60s the University almost went bankrupt, though in the math department some hiring continued, as noted above. In 1966 the State decided that the University of Pittsburgh had to survive, and rescued it. From then on, Pitt has been a State supported institution. Once finances were on an even keel again, it could grow and improve. And Litchfield may have given the faculty and administrators at the University the ambition to do so.

Modern Undergraduate Program

Turning to the undergraduate program, calculus has been taught at Pitt at least as far back as records go, which is to say 1861. Today calculus teaching is an important part of the mission of almost all math departments. Each term, well over half of the students taking an 0200 or above math course are enrolled in one of the first two semesters of the scientific calculus sequence, now numbered Math 0220 and 0230.

When I arrived, the organization of calculus teaching had undergone recent changes. In the early 80's, a majority of calc 1 and 2 sections had fewer than 40 students, met four times a week, and were taught by graduate students, though some faculty taught these courses also. A faculty member was course leader and gave guidance to the grad students involved.

But in the mid 80s, before I arrived, a switch was made to the current lecture-recitation system. There were then some very large lecture sections, of as many as 300 students, as well as a few sections of 40. All lectures were given by faculty, three times a week, and grad student – led recitations were twice a week.

The late 1980's and early '90s were times of foment in methods of teaching calculus. A major reason was the advent of computers as a possible instructional tool. Software had been developed which could handle the required computations, such as evaluating integrals and derivatives, and graphing. Even pocket calculators could plot curves. In our department two younger tenure stream faculty and the leader of our precalculus program took on the challenge of reforming how we taught what were then called math 22 and 23. Calculators were also introduced into precalc courses, which was possible because of Texas Instruments devices which tried to model MacIntosh computers as much as possible. The use of undergraduate teaching assistants also began in this time.

The faculty involved in reforming first year calculus teaching were intrigued by a program from the University of Illinois, and also by one developed by a consortium based at Harvard. They were interested enough to apply for, and receive, a coveted grant from the National Science Foundation to fund a computer lab devoted to calculus instruction. To see how the first term of scientific calculus changed as a result, look at these excerpts of two course descriptions, from Fall 1988 and Fall 1994. (What I include does not accurately show the difference in sizes between the two descriptions. The 1994 version was three times as long as that in 1988.)

1988-89

Math 22 (See particularly item 5.)

1. Content. This is the basic calculus sequence intended for all mathematics, engineering, science, and statistics students. Math 22 covers the first part of calculus of a single variable. . . . .
2. Prerequisites. For Math 22, Math 3A and 3B (precalc classes) are required. . . . .
3. Requirements and Grade. The grade is determined by three hour exams and the common final exam
4. Recitations: Two 50 minute recitations per week are required. . . . .
5. CLASS SIZE: All courses have three MWF lectures and two intervening recitations. . . . **With (three) exceptions, lecture size is 75-90. In fall we schedule three lectures of Math 22 with 250-300 students each.**

1994-95

Math 0220

1. This is the first course in the basic calculus sequence. . . . . This Fall, 95-1, you may choose among several instructional approaches as follows . . .

   A16, D16, Calculus and Mathematica. This is a lab course based on the interactive Calculus and Mathematica electronic textbook developed at the University of Illinois and Ohio State. . . . . Students are expected to spend an average of six to nine hours per week in the lab (including class time). As an additional reward, students will be trained in the use of a mathematical computer environment . . . . .

   C16, F16, M16, N16, O16 Traditional Calculus 1: lecture, recitations, textbook by Stewart, without graphics calculators or computers and with traditional expectations.

   B16, E16, G16. Harvard Calculus with Mathematica. These sections are based on a new curriculum developed by a consortium based at Harvard University. . . . . .In addition these two sections will include a weekly lab session in which you will work in small groups using the state of the art computer mathematics program Mathematica. . . . .

   H16, K15 Harvard Calculus with Graphing Calculators. „,(Similar to the above but with graphics calculators replacing Mathematica.

2.,3.,4., (similar to 1988-89)

5. **Class Size: Lectures 25-75, recitations 25-30**

At the end of the semester, the same final exam was given to all the sections, written by the instructors of the traditional calculus. Students taking the new versions scored on average higher than those in the traditional sections. However, one can argue that the increased enthusiasm of the teachers in the reformed sections played a role in this improvement. Also, it is possible that the students who chose something new were more excited about math to begin with than those choosing a traditional route. Two years later the faculty in the department were asked to vote on whether to continue offering a computer-based approach. They voted against doing so.

The department was left with an expensive computer lab meant for calculus instruction and no material to use in that lab which was compatible with the chosen traditional style text. Fortunately, a popular lecturer stepped forward, and with a lot of work adapted a physics oriented system called Lon Capa to mathematics, creating an extensive series of computer graded exercises which is still being used today.

Except for these efforts in calculus reform, the first two years of the current undergraduate curriculum look much as they did during my time in the third floor corner office. Math is a subject which, on the undergraduate and first year graduate levels, changes slowly. This is because most advances in math build on what came before, and cannot be understood without extensive background. However in recent years the list of possible undergraduate programs in the department has expanded, giving a wider range of courses offered to follow basic calculus and linear algebra.

Final Remarks

Although the undergraduate course offerings in the Pitt math department now are similar to those of thirty years ago, there is one noticeable difference in the delivery of these courses now compared to then. This difference is not just at Pitt. It reflects national trends.

In 1994, most calculus courses were taught by faculty who also did research. Now almost none of them are. There was not then a group of faculty in the Pitt math department who had Ph.D.s in mathematics and who aim for careers where teaching is more of a focus than research. Now almost all of the research faculty teach upper level or graduate courses, and the teaching faculty handle most calculus (and precalculus) classes, as well as some upper division courses.

I have made no study of the effect of this change, but I suspect that the average level of calculus instruction has gone up. Teaching faculty are hired because they have a record of good teaching at the undergraduate level. Teaching is important for research faculty also, but their advancement depends on both their research and their teaching. Their efforts are divided between these two areas.

But I regret that most research faculty, many of whom are also fine teachers, no longer seem interested in lower level instruction (mainly calculus). I wonder if the atmosphere of innovation and experimentation generated by those young faculty members thirty years ago has any chance of recurring under the present system. Their experiment did not win faculty approval, but surely there should be room for someone with new ideas to try again.

Despite abandoning the attempt to teach calculus with the aid of computer algebra systems such as Mathematica,[xxv] the principal long term changes in mathematics at Pitt during my time as chair were still in the use of computers. When I arrived in 1987, most computer activity in the department, other than for email or non-mathematical word processing, was for research in applied mathematics, and carried out on large "mainframes", such as those made by a company many reading this will never have heard of: Digital Equipment Corporation, or DEC, located in Boston. Macs and PCs existed, as did email, but mathematical word processing was in its infancy. When a faculty member wrote a research paper, they took it to a departmental secretary, who would type it on specialized typewriters which could produce mathematical symbols. The same went for departmental exams. A good mathematical typist was a valuable member of the staff in the department. Few, if any, faculty could claim this ability. Now, as far as I know, all faculty do their own typing, using some version of the mathematical typesetting system LaTeX. Further, computers play an important role in many areas of mathematical research, pure as well as applied. Modern desktop computers are far more powerful than the behemoths of 30 years ago, and government or industry sponsored "supercomputers" are available to academic researchers whose needs exceed what they can have at their fingertips every day.

As preparation for writing this article, I wrote to those current faculty who were teaching in the Pitt math department before 1995 and to some retired faculty for whom I had email addresses, asking for reminiscences about the years when I was chairman. I received replies from the people I thank in the Acknowledgements. Many were useful and influenced what I wrote, but one response was an essay in itself, giving a lively description of scientific computing in the 1980s. Many thanks to Dr. John Burkhardt for his reminiscences, which constitute the appendix below.

The period 1987-95 saw change of another sort as well, as there was quite a lot of faculty turnover in that period, with people leaving, for various reason, and younger people being hired. Research areas in most departments evolve over time, as personnel change. For example the arrival of Professor McLeod in 1987 brought increased activity in what came to be called applied analysis, which usually involves the study of differential equations, ordinary or partial, arising in the physical sciences or engineering. In the 2000s, when McLeod and some other applied analysts retired, and new people hired, research in the area moved in other directions.

In the late 1980s, the department's expertise in differential equations was largely focused on ordinary differential equations, and it was recognized by all the more applied parts of the department that a specialist in partial differential equations was needed. We got permission to hire above the entry level for this position and over a couple of years interviewed a number of senior candidates. We made two offers which were refused, the second of which failed when the applicant's wife, a distinguished medical researcher, was not satisfied with an offer made to her by the Pitt medical school. The following year we broadened our search to include younger candidates, and received an application from an outstanding young person in the field just finishing a post-doctoral appointment. We successfully persuaded him to join us in preference to an offer he received from Northwestern University. Coincidentally, later in the same year we were hiring a replacement in our (pure) analysis group and our potential recruit also had an offer from Northwestern. We won that contest too, and I was happy to tell the Dean that we had bested a fine math department twice that year in our hiring.

Other personnel challenges during my term as chairman were not about whom we hired, but about whom we wanted to keep in the face of an outside offer. Sometimes nothing can be done, as when a close Pitt colleague and collaborator of University Professor C. R. Rao died. As a result, or so I believe, Rao moved to Penn State, where he had other contacts. But when University Professor (in waiting) Bard Ermentrout received an offer to join an excellent research group at the National Institutes of Health, I was able to negotiate with Professor Rheinboldt to fill a vacancy in numerical analysis with a computational mathematical biologist. For this and other reasons Bard stayed, and our math biology program flourished.

I mention this story as an example of what keeps a department chairman awake at night!

And I use it also to complete my story. In accordance with my charge from the editors, I have discussed very little from after 1995, and hope that in the future someone with more knowledge than I of this later period will carry the story further.

Acknowledgements

I wrote to the faculty who were here when I was chairman and who are still in the department or are Emeritus. Thanks to all who replied: Angela Athanas, Frank Beatrous, John Burkhardt, Greg Constantine, Satish Iyengar, Bill Layton, Juan Manfredi, Beverly Michael, George Sparling, and Bill Troy. Several interesting replies, particularly about some outstanding undergraduates, concerned the period after 1995, so were beyond the scope of this article.

Thanks to Juan Manfredi also for the loan of two of the items in the References below.

Thanks also to the reviewer for a careful reading and a variety of suggestions which improved the article. Indeed, they played the role of an editor as much as that of a

referee.

I made many visits to the Pitt Archives, and wish to thank the people at the Thomas street facility who made me feel welcome, including the security guard. There I could access those University catalogs which were not available online and thus feel like a real historian. I also want to thank Carol Miller, from the Registrar's office, who dug up useful information for me.

Perhaps my most satisfying discovery was the story of our first Ph.D. awardee, as I thought, the one who ended up at M.I.T. But later I learned from a senior faculty member that he had known of this graduate for years and had even read his doctoral thesis. And then I discovered that the person I had focused on was not our first student to get a Ph.D. , but our second. So perhaps a historian's life is not for me.

Appendix (Dr. John Burkhardt)

I had funding as a graduate research assistant and then as a full time employee, working with Chuck Hall, Tom Porsching, Charlie Cullen, Werner Rheinboldt, Jim Fink. At the time that the math department was still in the 8th, 9th and 10th(!) floors of Schenley Hall (now the Pitt Student Union), I think computing was done through the Pitt Computing Center on a DEC VAX10 running VMS. The main location was in Old Engineering Hall, where a very noisy line printer was surrounded by people anxiously hoping for their output. Nearby there were a number of card punch machines, where you could painfully type your cards; however you typed carefully because if you made a mistake, you had to throw that card away.

Computer access was strictly controlled and accounted for. In my first numerical analysis class, we were given the assignment of setting up and solving a linear system $A\mathbf{x} = \mathbf{b}$, using a package called Linpack, which contained 30 different solvers, depending on the type of matrix being handled. I was still new at programming, but very stubborn, so when one solver didn't work the way I expected, I would try the next one, and so on. I was very embarrassed when Chuck Hall announced to the class that the entire semester's computer time allocation had already been used up by ... well, you can guess who. Luckily, it was explained to me that computer time was really "funny money" and so we got back in the game, and I promised to be more cautious in my experiments.

At some point, I was told that up the hill, in the Computer Science building, there was an interactive terminal that allowed you to talk to the computer. I thought this was the most ridiculous idea I had ever heard of. As far as I knew, computing required careful preparation of a sequence of formulas, which were then processed to spew out a table of results. This seemed to have no relationship to a "conversation". I never investigated this resource.

Our research group had made some arrangements with the Electric Power Research

Institute (EPRI) and through them we were given access to a CDC Cyber 6600 computer. However, instead of using cards, we had to use a terminal. This meant we had to call a special number on the telephone, then when we got connected, we had to nestle the telephone into the soft rubber "ears" of the terminal, and squint at the dim gray one-line screen that registered our interactions. So suddenly I had to learn how to have this conversation with a computer that I had been avoiding for so long. Worse yet, the CDC machine used a different operating system called COS, rather than the DEC VMS system. So we had to learn a new set of commands in order to get the computer's attention, transfer a file, compile it, execute the program and recover the results. And even worse, the Fortran compiler on the CDC machine required a much older and stricter version of Fortran. The fluid flow program we had was thousands of lines long, and had many hundreds of comments. The older compiler regarded every one of our comments as a "mistake". Having your first program rejected with thousands of errors was a depressing beginning to this relationship. After taking our wounded program back home, we were able to rewrite it to make the CDC happy, and started getting useful results for problems that had been too big to run at Pitt.

There came a time when the math department was banished from Schenley, and the applied group moved to the no longer existing Mineral Industries Building. Somehow, we had managed to get our very own supercomputer, a cast-off PDP11. This constituted our own special computer center, along with a Tektronix graphics terminal, and a DEC LA120 terminal/printer (whose printer head flew back and forth across the paper, printing in both directions). The PDP11 of course had yet another operating system, a version of Unix. We forced our hapless secretary to use this system to prepare all the technical reports of our group. This was cruel, since the editor could only accept a small amount of input before the document had to be saved and reloaded. Otherwise the document would "overflow", and the secretary's eyes would also overflow with tears of frustration.

When the math department was reunited in Thackeray Hall, a change in the rules of NSF funding meant that it was possible for research groups to use grant money to buy their own computers, rather than subsidizing university systems. So our group joined Physics, Chemistry, and Crystallography in a (disastrous) coalition, buying our own VAX system, as well as an FPS vector processing device (whose parent company's primary business was in pumps and air conditioning), as well as a surplus movie machine. To house all of this equipment, the room currently known as 704 Thackeray got a raised floor, a massive air conditioning system, and its own power supply.[xxvi] We also hired a computer technician to sit in 704 every weekday from 9 to 5, to mount tapes, monitor the paper supply, and push buttons as needed, as well as a systems analyst.

All of this machinery, power, and human resource required cash; this cash was drained from research grants of the four departments in the group; there was an initial buy in, but then there was supposed to be a regular stream of cash charged based on computer usage. For various reasons, this system didn't work; the computers weren't used, some of the participants dropped out and returned to the shared but essentially free (remember, "funny money") university services, but we still had to pay the electricity bill, the employees, supplies and so on. Sadly, we essentially had to go bankrupt; the equipment was taken back, and we all went back to the university systems.

However, by this time, personal computers were becoming powerful enough to handle a lot of the simple and small computing tasks, the Internet was making many possibilities available for getting work done at other sites, and the Pittsburgh Supercomputing Center, in particular, offered free computing (after approval of a research proposal) to NSF researchers as well as for classroom projects.

That's the jumble of recollections I can offer at this time...

Notes

[i] This and other information in this article about faculty, classes, student numbers, course requirements, etc. came from Pitt catalogs. All catalogs from 1927 or earlier are available on line through the Pitt library. All after 1927 are at the university's archives on Thomas street in Pittsburgh

[ii] When I arrived, statistics courses were already listed separately in the University catalog. The stat faculty felt that they would do better in recruiting new faculty and graduate students if they were a separate department, a change which had already occurred at some other universities. The process leading to this change at Pitt was under way even before I was chairman, and completed a couple of years after my term ended. The main hurdles that had to be cleared were in the higher administration of the University.

[iii] I have tried to determine the publication record of some Pitt math faculty from before 1960 by entering individual names in Google Scholar and JSTOR. Each of these sources includes early material, but not all journals are completely digitized and therefore searchable in this way. So my information is likely to be incomplete.

[iv] The 1790 census gives various figures for different parts of Allegheny County. It is very unclear what was considered Pittsburgh then, or what the population was. Nothing I found indicated anything more than 2000.

[v] Several websites claim 40,000, but according to the census bureau, at https://www.census.gov/history/www/through_the_decades/fast_facts/1790_fast_facts.html, the first census, conducted in 1790, found 28,682.

[vi] "Did you know" that the Panama canal was built mostly with steel from Pittsburgh, which for decades was the largest steel producing city in the world?

[vii] Presumably the “Learn-ed” Languages were Greek and Latin, perhaps French and German. Judging by the Oxford English Dictionary, “Mathematicks” was used in Gulliver’s Travels in 1726, but was obsolete by 1789. Apparently this news had not reached Pittsburgh.

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[ix] Initially the university occupied a single building near the Point, where the three rivers meet. Soon it moved to one and then two buildings near Third and Cherry, still downtown. After the fires it struggled in various downtown locations, then in 1882 moved across to the north side, in the vicinity of the Aviary. Around 1890 some classroom buildings were built in the area around the Pitt Observatory, still on the north side. Starting in 1908, the campus was gradually moved back across the river to Oakland, where construction of the Cathedral of Learning began in 1926.

[x] Note the language: It appears that an “artisan” to the mathematician is a “mechanic” to the historian.

[xi] Former Dean of Arts and Sciences John Cooper gave permission to use this quote.

[xii] It was no disgrace in 1862 for Pitt not to have a math professor with a Ph.D. No Ph.D.’s were awarded in the U. S. until 1861, and the degree didn’t exist in England until 1917, brought over from America.

[xiii] In order to be admitted as a Freshman you needed to “be well versed” in two sections of Robinson’s Algebra, a book which touted itself as covering both high school and college algebra. But college algebra was not the “modern algebra” begun by Galois and others in Europe in the 1830s. This topic did not appear in the Pitt curriculum until 1925, when ”Mr. Culver” , a graduate student, first taught a course in Finite Groups.

[xiv] At one point there was a division of the University consisting of Engineering and Chemistry. Physics seems to have been no more prominent than mathematics.

[xv] The Thaw brothers were sons of William Thaw, a railroad investor whose many gifts to the University included the money to build Thaw Hall, original home of the Pitt Engineering school.

[xvi] The 1909 Pitt Board also included an astronomer, a banker (Richard Mellon), a former Pitt chancellor and future director of the Carnegie Museum, a clergyman, Professors of Real Estate and Chemistry, a civil and mining engineer, the first subsidized athlete at Pitt, who later was an investor in oil wells around the world (Trees of Trees Hall), and a wholesale grocer (to half the state).

[xvii] The 1909 Penn Board included seven lawyers or judges, six businessmen or financiers, two politicians (including the Governor ex officio), two doctors, and an actor, a publisher, a bishop, a surveyor, an author, and an electrical engineer.

[xviii] Rapid growth in the College started during World War I and continued in following decades.

[xix] The Monthly, while of high quality, is not primarily a research journal.

[xx] Time Magazine's article mainly concerned Hawkesworth's 1936 letter to Science, which attacked Hubbel's theory of Universe expansion. The courses he is listed as teaching would today be considered excessively specialized material on conics. I suspect they were not a great draw even then, for he lasted only one year at Pitt, though he remained in Pittsburgh as a minister until 1917.

[xxi] Then, as now, perhaps the most prestigious math journal in the country.

[xxii] Culver's thesis title was "Some Special Types of Collineation Groups"

[xxiii] den Hartog's thesis title was "Forced Vibrations with Coulomb damping"

[xxiv] Barsotti published at least five papers during his time at Pitt – one in the Transactions of the American Mathematical Society and four in the Illinois Journal of Mathematics. In the year before he came to Pitt he had been a visitor at Princeton, and a paper which he wrote during that year appeared in the Annals of Mathematics.

[xxv] A quick survey of a number of other universities indicates that most today are using a traditional approach, with many, like Pitt, adopting a text by Stewart first published in the early 1990s. However Harvard calculus survives in several places. (Harvard itself seems to use in-house material, but I am not sure if it is the same as what we used in the mid 90s.)

[xxvi] All that equipment supported computers with less that 1/1000th the computing power of today's PC!

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