From the Chair

Paul Goerss, Department Chair

The department here at Northwestern University is a rich and diverse community, working together to study and teach mathematics. All of us contribute, each in his or her own way, to the overall project. We are a welcoming group, with an incredibly rich slate of visitors, special lectures, and any number of conferences. It is also an ever-changing and ever-renewing community. One of the great benefits to being Chair of the department is that I get to meet and get to know all these remarkable people. Here is some news about some of them.
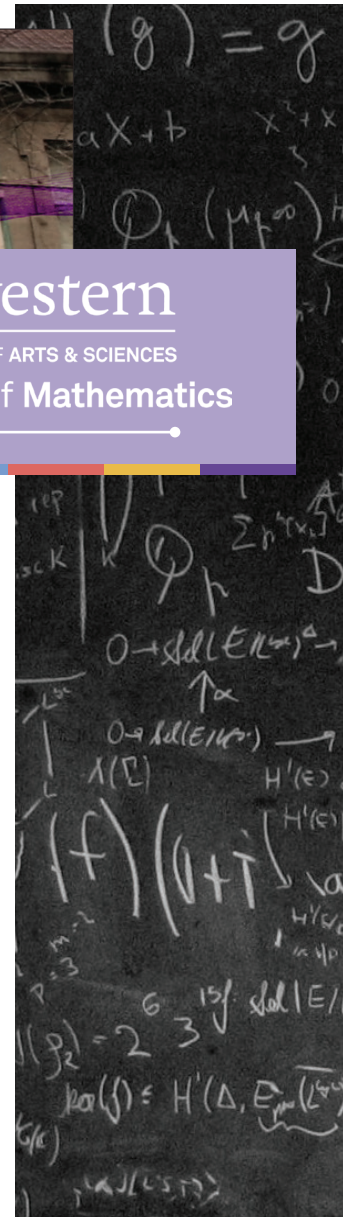
Our research faculty had a remarkable year, recognized in many ways. Tuca Auffinger won an NSF Career grant and has been promoted to Associate Professor with tenure. Yifeng Liu and Gang Liu have been awarded Sloan Fellowships, and Ezra Getzler has earned a Simons Fellowship, joining Bryna Kra who currently holds a Simons. Laura DeMarco was awarded the Ruth Lyttle Satter Prize in Mathematics at this year's joint meeting of the American Mathematical Societies, and she will be going to the International Congress of Mathematicians in Rio de Janeiro as an invited speaker. She will be joined there by Mihnea Popa and Emmy Murphy. Emmy herself is a recent Birman Prize winner and a Radcliffe Fellow.

Great mathematicians visit as well, both in our weekly seminars and in more exceptional events. Every two years Northwestern awards the Nemmers Prize in math, a prestigious honor given for path-breaking mathematics. This spring, the 2016 winner, János Kollár from Princeton is in residence. We also have two prestigious lecture series each year: Jacob Lurie from Harvard was the Bellow lecturer and Mircea Mustaţă of Michigan was the Pinsky lecturer. Professor Kollár's visit dovetails well with the ongoing emphasis year in algebraic geometry, run by Mihnea Popa, Ezra Getzler, and Yifeng Liu, which brings in its own visitors, both individually and through a series of conferences. The emphasis year is a remarkable departmental tradition going back to 1973.

Conferences don't need to be entirely about research. In the fall we had the second Graduate Research Opportunities for Women (GROW) conference. Both years were remarkable successes: the first year had 60 attendees and the second 80. GROW will be held again in October 2017. There will also be a summer school for graduate students, run out of our NSF Research Training Grant in Geometric Analysis.

Teaching is equally part of the profession and there is plenty of news there as well. Associate Chair Ursula Porod was promoted to Associate Professor of Instruction this spring. Santiago Cañez is in his second year as an Assistant Professor of Instruction and

Newsletter

Summer 2017 Issue

Photos left to right: Reception for Aaron Naber (with medal), Deavon Mitchell (front), Tuca Auffinger (standing)

Department News

Santiago Cañez Wins Weinberg Teaching Award

Congratulations to Santiago Cañez, who was named a recipient of an Arts and Sciences Alumni Teaching Award in Weinberg College for 2016-17.

Department Faculty Awarded NSF Career Award

Congratulations to Tuca Auffinger on being awarded a National Science Foundation Career Award, the foundation's most prestigious award in support of early career-development.

Department Faculty Awarded 2017 Simons Foundation Fellows in Mathematics Award

Congratulations to Ezra Getzler for receiving a 2017 Simons Foundation Fellows Mathematics Award for studies in Supersymmetric Field Theories and Derived Geometry.

Department Faculty Selected as 2017 Sloan Research Fellows

Congratulations to Gang Liu and Yifeng Liu on winning Alfred P. Sloan Foundation 2017 Research Fellowships.

Encouraging Young Mathematicians

Silas Johnson to hosted a mathleague.org contest for elementary and middle school aged mathematicians on March 19th. Over thirty students from two schools were in attendance.

Valentino Tosatti Appointed Poincaré Chair

Congratulations to Valentino Tosatti who was appointed to the 2017 Chair at the Institut Henri Poincaré.

Faculty Awarded the 2017 AMS Ruth Lyttle Satter Prize in Mathematics

Congratulations to Laura DeMarco for being honored for fundamental contributions to complex dynamics, potential theory, and the emerging field of arithmetic dynamics.

Featured Interview with Undergraduate Eugene Wu

Undergraduate Mathematics double-major Eugene Wu was published in a feature interview on his internship at Argonne National Laboratory in *Northwestern Career Advancements* publications.

Congratulations to the Newest Fellows of the American Mathematical Society

The Math Department congratulates Alexandra Bellow and Ben Weinkove on their election as 2017 Fellows of the American Mathematical Society.

Staff Member Recognized with Mentor of the Year Award

Deavon Mitchell was honored with the Mentor of the Year Award from the Weinberg College of Arts and Sciences.

Department Announces Emphasis Year in Algebraic Geometry, Number Theory and Physics

Department hosted a series of events and distinguished visitors for the 43rd annual Emphasis Year.

Mike Stein Retirement

Jared Wunsch

"What's the definition of an outgoing mathematician? One who looks at *your* shoes while talking to you." That's one of Mike Stein's favorite jokes. Mike, who retires at the end of this year after 47 years at Northwestern, is famous among undergraduates for starting each lecture with a joke, a different one each day throughout the year. Not only does this warm up the audience, he says, it ensures punctuality, as students have incentive not to miss the punchline. Mike is an extremely outgoing mathematician himself, and has had a profound effect on life in the department, the college, and the university in his time at NU.
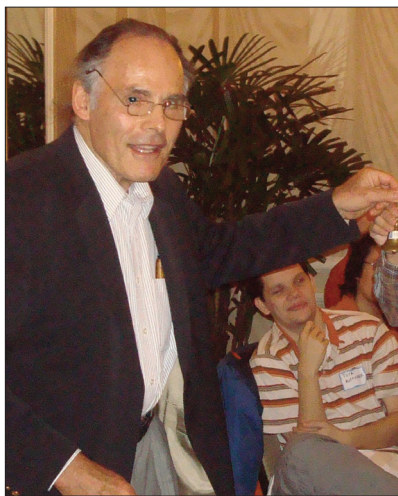
Mike got his Ph.D. from Columbia in 1970, working with Hyman Bass; he arrived at NU that fall as an Assistant Professor, and has been here ever since, as Assistant Professor, Associate Professor and Full Professor, and additionally as Director of the Integrated Science Program from 1988-1993 and Associate Dean for Undergraduate Studies in WCAS from 1993-1998. He has held visiting positions at Hebrew University,

Mark Pinsky (1940-2016)

Elton Hsu

Mark at a dinner in his honor in 2014.

Mark Pinsky obtained his Ph. D. in 1966 from MIT under the supervision of Henry McKean. After two years at Stanford, Mark came to Northwestern University as an assistant professor in 1968. He reached the rank of full professor in 1976 and retired from that position in 2012.

Mark worked in probability theory and stochastic analysis. Early in his career, he studied the Boltzmann equation and random evolution theory, culminating in a research monograph *Lectures on Random Evolutions*. Then he turned his attention to the emerging area of stochastic differential geometry. Mark was the first to introduce and made effective use of a matrix form Feynman-Kac functional. He worked on classical Fourier and harmonic analysis throughout his academic career and was known as the eponym of a phenomenon in multidimensional Fourier analysis akin to the classical Gibbs' phenomenon.

Mark authored over 100 scientific papers and was a fellow of the Institute of Mathematical Statistics.

Mark has taught many courses at Northwestern and turned his classroom notes into numerous undergraduate and graduate textbooks, which were adopted by many universities and colleges. These books include *Ordinary Differential Equations with Mathematica*, *Partial Differential Equations and Boundary Value Problems with Applications*, and I*ntroduction to Fourier Analysis and Wavelets*; some of them went through several editions. Mark visited many universities and research institutions during his career and organized many scientific conferences. He co-founded the highly successful Integrated Science Program at Northwestern and served as its second director. His most enduring legacies to the Mathematics Department are the Joanna and Mark Pinsky Distinguished Lecture Series established in 2008 and the Midwest Probability Colloquium, the annual probability conference at Northwestern Mark helped co-found and ran single-handedly for a long time, now in its 39th year.

Mark Pinsky, Professor Emeritus, died on Dec. 8, 2016 of complications due to Parkinson's disease. He is survived by his wife Joanna, three children Seth, Jonathan, and Lea, and four grand children.

2016/2017 Undergraduate Prize Winners in Mathematics

Robert R. Welland Prize for Outstanding Achievement in Mathematics by a Graduating Senior

Araminta Gwynne, Samuel Mossing

Honorable Mention for Achievement in Mathematics by a Senior

Harris Khan

Outstanding Achievement in Mathematics by a Junior

Ethan Dlugie, Benjamin Ekeroth

Honorable Mention for Achievement in Mathematics by a Junior

Nicholas Irons

Outstanding Achievement in Mathematics by a Sophomore

Alexander Ortiz, Aidan Perreault

Honorable Mention for Achievement in Mathematics by a Sophomore

Thomas Ritz, Robert Smart, Timothy Zhou

Excellence in Mathematics by a First Year Student

Ryan Broll, Amy Chen, Kathryn Julia Dierksheide, Hakan Dingenc, Akshay Jain, Minsoo Kang, Justin Lin, Owen MacDonald, Xudong Tan, Mahir Wagh, Shiwei Wang, Yin-Liao Wang, Huiran Zang, Jinming Zhang

Outstanding Contributions to Undergraduate Mathematical Life

Rachel Gallegos, Samuel Mossing

High Achievement on the William Lowell Putnam Examination

Ruohong Zhang

Excellence as an Undergraduate Teaching Assistant

Matthias Wuest

Certificate of Recognition for Service as an Undergraduate Teaching Assistant

Daniel Kinch, Sam Piehl, Justin Trousdale, Matthias Wuest

Excellence as an Undergraduate Teaching Assistant winner Matthias Wuest with Ursula Porod

Robert R. Welland Prize for Outstanding Achievement in Mathematics by a Graduating Senior winner Araminta Gwynne with Paul Goerss

Excellence in Mathematics by a First Year Student winners Shiwei Wang, Hakan Dingenc, and Kathryn Julia Dierksheide

The Undergraduate Program 2016-2017

John Alongi, Incoming Director of Undergraduate Studies

Traditionally, the end of the academic year is a time to recognize the accomplishments of our students and faculty. This year we expect 100 students to graduate with either a major or minor in mathematics. Three of our graduating seniors–Araminta Gwynne, Harris Khan, and Sam Mossing–will pursue graduate study in the mathematical sciences. In particular, Araminta has earned a National Science Foundation Graduate Research Fellowship to support her graduate study at the Massachusetts Institute of Technology. Araminta, Harris, Sam and Malcolm Lazarow each wrote an honors thesis this year. We will recognize all of our seniors at this spring's undergraduate prize ceremony and dinner. This year's undergraduate prize lecture features Professor Jason Rosenhouse from James Madison University speaking about "The Monty Hall Problem, Reconsidered."

In other good news, junior Ethan Dlugie earned an honorable mention in this year's Goldwater Scholarship competition, due largely to his work with Professor Aaron Peterson on uniform global structures in unbounded domains. Their project culminated in a joint paper that will appear in the journal Involve.

Among our faculty, Professor Santiago Cañez won an Arts and Sciences Alumni Teaching Award this spring. Santiago has been deeply involved with our calculus courses and with outreach to Evanston Township High School. He also brings a fresh perspective to his new role as Director of Mathematical Experience for Northwestern Undergraduates.
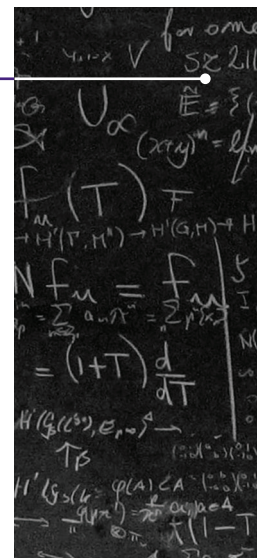
After 15 years as Director of Undergraduate Studies in Mathematics and 47 years as a faculty member, Professor Mike Stein will be retiring at the end of the summer. As a model for directors of undergraduate studies throughout the Weinberg College of Arts and Sciences, Mike leaves a thriving program with 224 majors and 25 minors. As the incoming Director of Undergraduate Studies in Mathematics, I would like to thank Mike for his service.

Finally, we are grateful to all of the alumni who donate to the department. Their donations help fund our undergraduate prizes as well as other initiatives that support the department's undergraduate teaching mission. Information on how to make a gift appears on the back page of this newsletter.

Mike Stein Retirement

University of London, the Weizmann Institute, University of Chicago, and University of Strasbourg, and was made a Fellow of the American Mathematical Society in 2013.

Mike's early work was in algebraic groups and algebraic K-theory, beginning an extended collaboration with Keith Dennis of Cornell University. With Dennis and in some related single-author papers, Mike proved important results in lower dimensional algebraic K-groups and Whitehead groups. Mike's former Ph.D. students include Reinhard Laubenbacher, who has had a very successful career that spans algebra, history of mathematics, and mathematical biology.
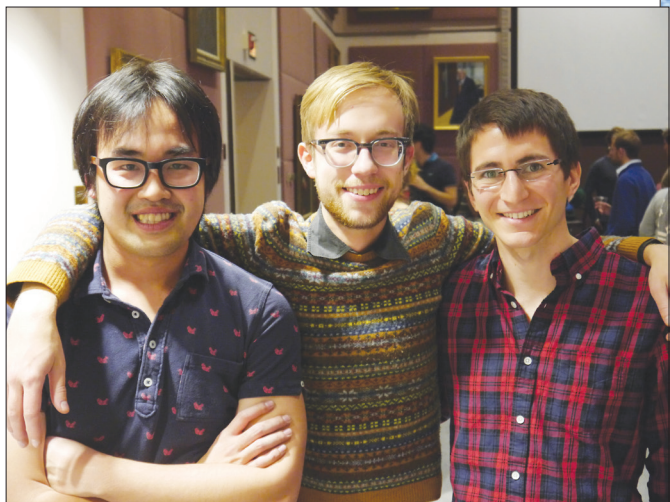
Mike has served as the Math Department's Director of Undergraduate Studies for the past 15 years; in that time, he has revolutionized Northwestern's math major. We have *doubled* the number of math majors since Mike took over in 2002, and the major has become both more inclusive of students with diverse career goals and more effective in advising and inspiring those bound for math graduate school. Among Mike's other initiatives as DUS were: expansion of our program of undergraduate prizes and the associated prize ceremony; formation of the Math Club; beginning the use of undergraduate TAs; the institution of TA prizes; and a host of curricular reforms and improvements. Mike is an outstanding classroom teacher himself, and takes a special pleasure in teaching our core undergraduate abstract algebra course; he was awarded a WCAS Outstanding Teaching Award in 1988, the Weinberg College Community Building Award in 2010, and was on the ASG Honor Roll in 2007.

Mike Stein is interested in *everything*, and one of the pleasures of having him as a colleague has been learning from him, not just about algebra and pedagogy, but also the answers to pressing questions like: What languages have the most phonemes? What are the best mystery novels set in Italy? And which insects are kosher?

We will sorely miss Mike's presence and all that he does for NU mathematics, but we wish him a very happy retirement.
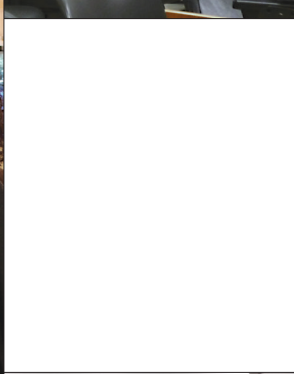
Photo Gallery

> **"The department here at Northwestern University is a rich and diverse community, working together to study and teach mathematics."**
>
> — Paul Goerss, Department Chair

From top left, clockwise: Graduate students at the Holiday Party; Graduate students at the Beginning of the Year Party; GROW 2016 particiants; GROW 2016 faculty panel discussion; GROW 2016 speaker Dusa McDuff and Northwestern professor emeritus Alexandra Bellow; Graduate students at the Beginning of the Year party

From top left, clockwise: Graduate students at the Holiday Party; Frosty the Snowman visits the Holiday Party; Class time; Director of Graduate Studies, Elton Hsu; Jason Rosenhouse gives the Undergraduate Awards Ceremony lecture; Araminta Gwynne with fellow GROW 2016 participants; Faculty members at the Undergraduate Awards Ceremony

Life at Northwestern: An Undergraduate Perspective

Samuel Mossing, Class of 2017

I'm very thankful for all the opportunities I have been offered since transferring to Northwestern three years ago. When I arrived I already had an inkling that I wanted to eventually pursue a PhD in mathematics, so my goal was to take as many challenging and interesting math courses as I could. As I reflect on these years now, I can say definitively that I accomplished this goal. I was immediately able to take advanced undergraduate courses through the MENU program, and in those MENU classes I received probably the best instruction out of all of my classes at Northwestern. Because of this, these courses served as a seamless transition into taking introductory graduate classes.

From there I was able to discover my more specific interest in analysis and begin to take more specialized coursework. I've never had a course which interested me that I couldn't take, and I've never had to stress over fulfilling course requirements since they were flexible enough to align naturally with my interests. The teachers I've had have been accommodating and open about both answering questions and giving advice, and my classmates have been uniformly intelligent and friendly.

I'm also thankful for the opportunities I've had outside of the classroom. I was able to get involved with the undergraduate math society immediately, and the weekly lectures hosted there have shown me many different problems and branches of math that I wouldn't have seen otherwise. My experience as an undergraduate TA was incredibly fulfilling both because I was able to help other students learn calculus and because I was able to practice teaching and interacting with others. The professors were very helpful in advising me on an undergraduate research grant, and the independent study I did that summer served as the foundation for my senior thesis. My adviser worked with me throughout my senior thesis, and that whole experience was a useful first practice at the kind of self-paced and self-motivated study that I will certainly do in the future.

These opportunities helped me broaden my education and I can't take them for granted. It's because I've been able to learn and participate in so much in the past three years that I feel so fortunate and prepared for my future as I get ready for graduate school next fall.

From the Chair

has taken over as the director of the MENU program. We've added Aaron Peterson to the ranks of the APIs; he will take over as Calculus Director next fall.

Another extremely important group for us is the postdocs, who are typically here for three years right after they earn their Ph.D. There are about a dozen Boas Assistant Professors—the research postdocs—and seven Postdoctoral Lecturers, whose primary mission is teaching. They are vital members of the department, but by the very nature of these positions, these mathematicians are with us for only a few years. We are always a little sad to see them go, but we take delight in their success: for example, Linhui Shen will be going to a tenure-track position at Michigan State, Guillaume Roy-Fortin has a similar position in Montreal, and Jason Seifken will leave us for a prestigious teaching postdoc in Toronto.

Finally, it is with deep regret that I write that Professor Emeritus Mark Pinsky passed away this past December. Mark is remembered as a vital and stalwart member of this department, as the founder and long-time organizer of the Midwest Probability Colloquium and, with his wife Joanna, for endowing the Pinsky Lecture Series.

Graduate Student News

Our graduate program had another successful year in 2016-2017.

Ten of our graduate students will earn PhDs this year: Michael Couch, Honghao Gao, Spencer Liang, Vlad Serban, Joel Specter, Rebecca Wei, Dylan Wilson, Lei Wu, Philsang Yoo, and Peng Zhou.

Peng Zhou received the annual Best Thesis Award from the department. The Gelfand Award, given for outstanding contributions to the graduate student community, went to Sean Pohorence, while the Best Performance on the Preliminary Examination went to Guillermo Tochi. Congratulations also to Anh Le and Maksym Chornyi who won the Department Graduate Teaching Assistant Awards.

The Department's big NSF Research Training Group (RTG) grant "Analysis on Manifolds" continues to benefit our graduate students, with graduate students working on analysis given additional time for research through reduced teaching loads as well as funding for conference travel.

The Big Buddy program is still going strong, with bigger buddies (second-year or up) having lunches with little buddies (incoming graduate students) and discussing with them any possible issues, or just relaxing and having a good time.

Our recruitment effort has resulted in a sizable new class of incoming graduate students: Eduardo Amaral, *University of California, Berkeley*; Georgy Belousov, *Higher School of Economics*; Willie Dong, *Columbia University*; Christian Gorski, *University of Notre Dame*; Yi Gu, *Rice University*; Yaroslav Khromenkov, *Higher School of Economics*; Grigory Kondyrev, *Higher School of Economics*; Luis Felipe Ledesma Vega, *McGill University*; Anthony McCormick, *University of Waterloo*; Fanjun Meng, *Fudan University*; Catherine Ray, *University of Chicago*; Roxane Sayde, *Barnard College*; Randall Van Why, *University of Chicago*; Ruoyu Wang, *University of Cambridge*; Matthew Weatherley, *Cornell University*; Mengxuan Yang, *Texas A&M University*.
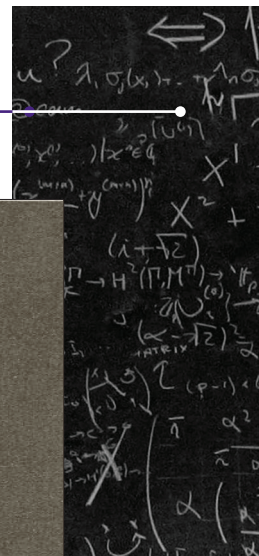
Thanks to the effort of our graduate students, our graduate community remains friendly as ever. We owe our special thanks to Shuyi Weng and Lei Wu for organizing our wine and cheese receptions and Greg Edwards for organizing our weekly happy hour.

Top Photo (Left to right) Graduate Students Xavier Garcia, Yajnaseni Dutta, Joel Specter, Kitty Yang, and Dylan Wilson in Lunt Hall; Bottom Photo (Left to Right) Kyle Casey, Maksym Chaudkhari, Jingjing Suo, Sid Wang, and Shuyi Weng at the 2016 Holiday Party

Excerpts from *A History of the Department of Mathematics at Northwestern University 1855-1905*

Prepared by Thomas F. Holgate, originally published 1941
Arranged and Edited by Emily Kefferstan

The Curriculum

During the first thirty years of the University's history there was little change made to the courses offered in Mathematics. The entrance requirements were advanced in 1866 to include two books of Loomis' Geometry and in 1869, three or four books of Davies' Legendre. The courses offered in the college were standard and embodied an extended course in Algebra, an introduction to plane and spherical trigonometry, the beginnings of analytical geometry as far as to include a study of the conic sections, differential and integral calculus and their applications to geometry. When courses were offered outside of this restricted field they were commonly in astronomy or in some of the simpler aspects of civil engineering, such as surveying, levelling, and navigation. All students were required to take the same courses which for freshmen met five hours a week for class instruction, and for upperclassmen, for the most part, three hours a week. In 1869 calculus was made optional for students in the classical course and no mathematics was announced for the senior year.

With the appointment in June 1888, of George Washington Hough as Professor of Astronomy and the completion of Dearborn Observatory in the following year, courses in Astronomy, which till then had been offered, if at all, in the department of Mathematics, were transferred to the new department.

Graduate Courses Offered

The Catalogue of 1894-95 first announced courses Primarily for Graduate Students. They were Theory of Functions and Substitution Groups by Professor White; Modern Higher Algebra, Higher Plane Curves, and an Advanced Couse in Modern Synthetic Geometry, by Professor Holgate. From that time forward there appears to have been an increased emphasis on graduate studies with a steadily increasing number of advance students, the courses being varied from year to year to meet the needs of the students registered.

During the year in 1894-95, Fanny Cook Gates, B.L., 1894, held a fellowship in Mathematics, the first to be awarded to the department. Her thesis for the Master's degree in 1895 was "On the Construction of Curves of the Second Order from five elements, some of which are Imaginary." Miss Gates continued her studies in Mathematics and Physics at Bryn Mawr College and

in Göttingen, Germany, was Professor of Physics at Goucher College for ten years and a student at intervals under Rutherford in Montreal and Sir J.J. Thomson in Cambridge.

In 1896 a new Instructor appeared to take the place of Mr. Annis- Mr. Herbert Govert Keppel, a graduate of Hope College, Michigan, and a student at Clark University for the four years preceding his appointment at Northwestern. He remained with the department until 1908, except for the year 1900-01 when he was on leave of absence for further study at Clark, resulting in the PH.D. degree. In 1908 he was appointed Professor of Mathematics in the State University of Florida where he remained until his death in September 1918. The autumn of 1897 brought an additional Instructor in the person of Dr. Henry Freeman Stecker of the University of Wisconsin who remained with the department until 1900 when he received appointment at Cornell University. Mr. Burke Smith, a graduate of the University of Washington was Instructor during Dr. Keppel's absence in 1900-01.

Class Rooms Occupied

For the first fourteen years of the work of the University, the mathematics class-rooms were in the first building erected which came later to be known as Old College and still later became the home of the school of education. With the erection of the University Hall and its occupancy in 1869, the rooms used by the mathematics department were on the first floor of that hall, at the left as one enters the south door, the large room No. 3, being the class-room and the smaller one, No. 4, the instructors' office. It was in these rooms that Professor Kellogg, Professor Moore, and Professor White conducted classes and advised students. Many traditions linger there of the qualities and influence of those distinguished teachers.

In 1909 the office and class-rooms of the department were moved to Swift Hall of Engineering, newly constructed on a gift of Mr. Edward Swift and Mrs. Gustavus Swift, his mother, for the housing of Engineering, Physics, and Mathematics.

Thomas F. Holgate was an Instructor of Mathematics at Northwestern University from 1893-1934. Holgate was appointed the Dean of the College of Liberal Arts begining in 1903 before twice serving as president of Northwestern University from 1904-1906 and 1916-1919.

Courtesy of the Northwestern University Archives, *A History of the Department of Mathematics at Northwestern University 1855-1905* is one of Holgate's two unpublished historical essays on early life at Northwestern University.

Photography from top left, clockwise: Yearbook photograph of the Members of the 1921 Mathematics Club, Students exiting Lunt Hall (date unknown), Exterior of Lunt Hall circa 1896 when the building served as the University Library from 1894-1933. All photographs courtesy of the Northwestern University Archives.

Math Department Trivia

{1}   Which math professor wrote a book about Ultimate Frisbee?

{2}   Which two Mathematical Association of America presidents were on the Northwestern University faculty during their tenure?

{3}   Which Northwestern math professor seriously considered a career as a literary writer before deciding to become a mathematician?

{4}   Which faculty member was a synchronized swimmer?

{5}   Which math professor is an avid long distance runner who recently ran in the Boston Marathon?

ANSWERS - 1: Eric Zaslow; 2: David Curtiss, Ralph Boas; 3: Steve Zelditch; 4: Elizabeth Bursiem; 5: Keith Burns

We wish to thank our 2016-17 donors for their generosity

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Martha Goldberg Aronson '72
Lisa Bailey '71, '75 MD, '80 GME, '81 GME
Brian Richard Batten '14
Randal S. Beck '75 MA, '79 PhD
Alexandra Bellow
Christopher Paul Bendel '93 MS, '96 PhD
K. Richard Berlet '68
Emily Bradley Berson '16
Constance Poradyla Billerman '81
John D. Billerman
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Joseph W. Paciorek '66 MS, '70 PhD
Art Pancoe '51 MS, '08 GP, '13 GP
Gary S. Patrik '67 MS
Denise I. Patterson '76 MS
Elaine Blanche Pavelka '55, '56 MS

Amanda Jeanne Potts '10 PhD
Elizabeth Ann Powell '07
Janet Pranskevich
Teri-Ellen Naccarato Rogers '68
Gavin Eliot Rosen '16
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