Friday, October 17

2000-2050    Jeff Oaks, University of Indianapolis, *Algebraic notation in medieval Arabic*

Like most medieval books, Arabic books covering algebra read like transcriptions of lectures. This is due to the fundamentally oral nature of medieval Islamic civilization. Algebraic solutions to problems are written out in words, with no notation even for numbers. But problems were not solved rhetorically, of course. Algebraists would work out a problem in some kind of notation on a dust board or other ephemeral surface, and to record it in a book a rhetorical version of the calculations would be composed. From early texts it appears that only the coefficients of polynomials were written in Indian notation. But in the Maghreb in the twelfth century a notation specific to algebra developed in which the power was indicated also. This notation is not presented as a scientific development in the manuscripts, but is instead shown in textbooks to instruct students in its use. I will explain this notation and how it differs from modern notation.

Saturday, October 18

0900-0930    David Roberts, Prince George’s Community College, *An American Mathematics Textbook on the Eve of the Civil War*

In 1857 Daniel Harvey Hill, a professor of mathematics and civil engineering at Davidson College in North Carolina, published a textbook titled Elements of Algebra, aimed at the college market. Hill was a West Point graduate and a veteran of the Mexican War; he would eventually become a lieutenant general in the army of the Confederacy, with an ambiguous reputation. Unsurprisingly we can learn from Hill’s textbook something about the state of mathematical knowledge in the United States generally, and something about Hill’s understanding specifically; for example, he is quite proficient with symbolic manipulation, but he flubs a proof involving the fundamental properties of prime numbers. More surprisingly, we can also glean from Hill’s book something about his views on the pressing social issues of the day, notably slavery and women’s rights. This talk will touch on both aspects of Hill’s book.

0940-1010    Patricia Baggett, New Mexico State University, *Was John Napier the first modern computer scientist?*

The concept of a universal computing device, namely, a single device on which all possible algorithms can be executed, underlies the entire field of modern computer technology. Its invention is justifiably attributed to Alan Turing. We will argue that a “base-two counting board”, described by John Napier in the last chapter of his Rabdology, published in 1617, was a valid, although unsuccessful, attempt to create a universal computing device. Napier described one very simple set of rules for regrouping tokens on a checkered board, which allowed him to execute many arithmetic algorithms, but as we now know, not all of them.
1030-1100  **John Curran, Eastern Michigan University, Historical Role-Playing in the Mathematics Classroom**

I have been using historical role-playing games in two of my courses at Eastern Michigan University. The first is used in a quantitative reasoning course, and role-plays the passage of the Social Security act in 1935. The second is used in a mathematics history course, and reenacts the proceedings of the Devonshire Commission in 1870, which sought to reform education at Cambridge University, notably the mathematics curriculum and the Mathematical Tripos exam.

The games are based on the Reacting to the Past pedagogy that is used by many historians in their university courses. I will describe the method, my experience in using it, and the possibilities for extending it to other mathematics courses.

1110-1140  **Andrew Leahy, Knox College, Some early results about centers of gravity**

Many topics in the syllabus of a typical calculus II course can be traced back to Archimedes. Areas, volumes of revolution, polar coordinates and polar areas--simple cases of all of these ideas were first addressed by Archimedes himself. Ironically, centers of gravity, often one of the most neglected applications of integral calculus today, were a mathematical workhorse for Archimedes, and generalizations of his ideas on centers of gravity were some of the first questions posed and answered by mathematicians in the 16th and 17th centuries. This talk will look at some of these early results on centers of gravity, with a particular emphasis on the many connections between Archimedes' *Quadrature of the Parabola* and centers of gravity that were given by Evangelista Torricelli in his 1644 work *de Dimensione Parabolae*.

1150-1220  **Pierre Boulos, University of Windsor, Diagrams in Newton’s Principia: Pedagogical Aid or Mathematical Reasoning?**

In reasoning out the mathematical principles of natural philosophy Newton makes abundant use of geometric diagrams. It is not historical fiction to think that Newton might have used a tool developed for his own use in the publication of the Principia, namely the calculus. Had he used the calculus in the Principia it would have simplified the mathematical reasoning in it, and likely would have rendered the use of diagrams to pedagogical aid. Newton, a descendent of a long tradition, held that the most certain way of reasoning mathematically is diagrammatically. His added flourish to diagrammatic reasoning is to conceive the diagrams as capturing the “momentary” in motion. This departure was crucial in the establishment of his three laws of motion and, indeed, the argument for universal gravitation. For Newton, diagrams are essential to analysis and thus are essential to his deductions from phenomena.

1400-1500  **Fred Rickey and Adam Parker, West Point and Wittenberg University, Using History to Teach Mathematics: Two examples, some three-minute talks, and one discussion**

Many people who are interested in the history of mathematics strongly recommend its use to motivate and instruct students and there are many papers arguing for this position and enumerating its many benefits. But what the teacher needs is classroom-tested examples that work. Each of us will present one of our favorites. Then we will invite anyone who wishes to
make a three-minute presentation on one of your favorites (you can be spontaneous or bring a handout). Finally there will be a discussion by all present. A handout will be distributed.

1520-1550 Rebecca Vinsonhaler, University of Wisconsin-Madison, Unique pedagogies that help promote justification

Justification is at the heart of mathematics. In particular, undergraduate math classes work to develop mathematical rigor through written proofs. I believe that more attention should be given to justification in grades K-12. By working on the Examples Project I have gained insight into how students use examples at a middle school level, a high school level, and a college level. In analyzing how they use examples to prove conjectures, there is a common theme that algebra, an expression, or equation, is the only way to rigorously prove something. In looking at student responses it is clear that many middle school students see more structural elements and patterns through examples, than equations. Similarly, undergraduates miss the opportunity to gain insight through examples by jumping to algebra immediately. More attention needs to be given to how students promote not only proof, but justification, at early grade levels. The JAGUAR project analyzed how teachers orchestrate justification in their classrooms. By documenting teacher’s pedagogical approach to supporting students’ engagement in justification, we argue that there are unique ways to support the disciplinary practice of student justification. Here we analyzed two instances of extensive student justifications in seventh-grade classrooms and compared and contrasted the pedagogies of the two teachers. Specific attention was given to teachers’ responses to student ideas, the nature of teachers’ prompts geared toward reasoning and justification, the nature of the classroom culture, and how teachers designed and implemented tasks. In reviewing their findings, I argue that more attention should be given to pedagogies supporting justification in classroom, and that there are multiple effective strategies to encourage student justification.

1600-1630 Michael Todd Edwards, Engaging Preservice Mathematics Teachers in Mathematics History Research

In this presentation, participants discuss strategies for engaging undergraduates in teacher preparation programs in research projects involving the history of mathematics. In particular, we share work we've done at Miami University to support students as they conduct research, write, and publish original work in peer-reviewed mathematics teaching journals. We also discuss our efforts to create a new, student-run mathematics history journal using Open Journal Systems software through our library's Center for Digital Scholarship.

1640-1710 Chris Christensen, Northern Kentucky University, The Search for Hall’s Weights

The primary World War II Imperial Japanese Naval cipher JN-25 consisted of super enciphered 5-digit code groups. As a method of error-detection, JN-25 clear code groups were 5-digit numbers divisible by 3. Until the end of 1943, US Navy codebreakers were able to align JN-25 messages by breaking the indicator system, but Marshall Hall Jr., one of the mathematicians who were recruited by the Navy to be codebreakers, developed another method “just in case.” Beginning in December 1943, JN-25 codebooks changed in such a way that the Navy’s method of alignment was rendered ineffective, and there was a need for a new method. Hall’s weights were one option that the Navy explored. Hall based his weights on his belief that the differences
of the clear code groups were not uniformly distributed. This presentation will describe how a reasonable explanation of the calculation of Hall’s weights evolved during a two-year exploration of declassified Navy documents.

Sunday, October 19

0900-0930   Narida Ellington, Illinois State University, Dame Schools, Hornbooks, and the Mathematics Education of the Young before 1800

Much of the writing about the history of school mathematics has emphasized the evolution of mathematical studies which culminated in present (21st-century) secondary school mathematics curricula and in current methods of teaching of learning mathematics. This presentation will depart from that standard argument by throwing light on the mathematics which young British and North American children (aged between about three and eight years) were most likely to have learned, and how they were expected to have learned it, during the seventeenth and eighteenth centuries. Despite the fact that the word “hornbook” does not appear in the recently-published 634-page Handbook on the History of Mathematics Education (Karp & Schubring, 2014), most young school children in Europe and North America who were introduced to mathematics in the seventeenth and eighteenth centuries, were asked to learn to read, say, and write mathematical symbols, especially Hindu-Arabic numerals and Roman numerals, from hornbooks. Except in wealthy families, in which private governesses were employed for the education of young children, those guiding the children’s learning were the “dames” who conducted “dame schools.” This presentation will feature a history of the hornbook, and will also comment on the history of dame schools—the emphasis being on the teaching and learning of number. The question why hornbooks suddenly “disappeared” in Europe and North America around 1800 will be raised. Other little-discussed issues associated with the history of hornbooks in North America will also be considered—especially in relation to the writings on that theme by George Plimpton.


New Paltz is a historic town, about 80 miles north of New York City. It was originally settled in the 1670s by French Huguenots, and over the next 200 years the settlement drew many French, Dutch and British immigrants. Today, the Huguenot Historical Society, in New Paltz, holds about 25 cyphering books—these were summarized in Appendix B to Rewriting the History of School Mathematics in North America 1607–1861 (Ellerton & Clements, 2012). The early settlers of New Paltz had left their European homelands for essentially religious reasons, and in this presentation a summary of the cyphering tradition as that is reflected by entries in New Paltz cyphering books will be given. One of the central questions to be considered is: To what extent were New Paltz cyphering books similar to cyphering books prepared in other places with obviously different cultural environments? An analysis of entries in two New Paltz cyphering books held in the Ellerton-Clements collection—a 1775 cyphering book by Cornelius Houghtaling, and an 1840s cyphering book prepared by Gertrude Deyo—will be summarized, and findings linked to a survey of the cyphering books held by the Huguenot Historical Society. The conclusion reached is that, typically, students in New Paltz not only studied more arithmetic, but they also tended to study more difficult arithmetic, than students elsewhere. Furthermore, in
New Paltz, a higher proportion of girls than elsewhere prepared cyphering books; and, in the eighteenth century, sometimes the language of instruction and learning was French, or German, and not English.

1030-1100  James Smith, San Francisco State University, David Hilbert, Guest Speaker

In past years I concluded courses both in history and in advanced mathematics by playing and interpreting Hilbert’s inspiring 4-minute 1930 radio address, which ends with his famous motto, Wir müssen wissen, wir werden wissen (We must know, we will know). I’ve just published that material, including the audio file, in the MAA online journal Convergence, volume 11 (2014). This talk provides material on the background of the address, particularly with respect to Hilbert’s famous 1900 problem set. I will also discuss its use in instruction, and the new online format.

1110-1140  Amy Ackerberg-Hastings, University of Maryland University College, Sectors in the Classroom

This talk follows up on my presentations on slide rules and planimeters in the classroom at the 2012 West Coast and 2013 East Coast meetings of the HPM Americas Section. Sectors are mathematical instruments that have two arms, joined by a hinge, which are marked with various proportional, numerical, trigonometric, and logarithmic scales. The user employed a pair of dividers to transfer distances between the sectors and a drawing and to measure distances on the scales, effectively creating a series of similar triangles or proportional relationships. The instruments were used primarily in western Europe from the 17th to the 19th centuries. Surviving examples of sectors are typically finely crafted, rare, and expensive, so they are not as easy to incorporate directly into the mathematics classroom as slide rules or even planimeters. I will focus on how instructors might utilize the digitized images and catalog descriptions of 23 sectors held by the Smithsonian's National Museum of American History.

1150-1220  Colin McKinney, Wabash College, Divergent Series in the Classroom

A popular online blog, Numberphile, recently published a video on YouTube discussing the divergent series 1-2+3-4+..., and how it “equals” -1/12. The video (and statement of the “result”) subsequently went viral on social media, much to the chagrin of the general public and mathematicians alike. Shortly thereafter, Evelyn Lamb, Scientific American’s Roots of Unity math blog author, wrote a detailed post about ways in which we could view this result as actually making sense by using concepts from complex analysis.

In this talk, I’ll discuss how to bring this topic into a calculus classroom in a meaningful way, using techniques from the earlier sections of G. H. Hardy’s Divergent Series. Such examples can serve as a way to enrich discussions of divergence in the calculus classroom for both advanced students and others.