HPM Program March 2011

Saturday, March 12

8:30 – 9:00 On-site registration (coffee and muffins)

9:00 – 9:35 Chris Rorres (University of Pennsylvania), *Archimedes' Count of Homer's Cattle of the Sun*

In the first few lines of The Odyssey, Homer foretells how Odysseus' crew "perished through their own sheer folly in eating the cattle of the Sun-god Hyperion." These Cattle of the Sun grazed near the Sicilian town of Taormina and, although endlessly warned not to, Odysseus' crew slaughtered some of them for food. For this sacrilege Zeus tossed them from their ship to their deaths with his thunderbolts, leaving Odysseus to continue his odyssey alone. In describing the sacred cattle, Homer indirectly gives their count by writing that they comprised seven herds containing fifty cattle each (Book XII: "Of oxen fifty head in every herd feed, and their herds are seven"), leaving it to the reader to determine the total number of cattle. Centuries later this simple multiplication problem was the inspiration for Archimedes' famous "Cattle Problem", whose first line is: "If thou art diligent and wise, O stranger, compute the number of cattle of the Sun, who once upon a time grazed on the fields of the Thrinacian isle of Sicily." Archimedes, who lived in the Sicilian-Greek city-state of Syracuse, 85 kilometers south of Taormina, would have been very familiar with Homer's tale. In his problem, Archimedes challenges his colleague Eratosthenes to compute the number of the Cattle of the Sun having a larger and more complicated composition than the one described by Homer. Archimedes' problem is so complicated that the total number of cattle contains 206,545 digits. In this talk I describe the origins of this problem in antiquity, its rediscovery in the eighteenth century, and the attempts since then to solve it. These attempts fueled the field of Diophantine Analysis and, in particular, the study of the so-called Pell Equation. Today a notebook computer using sophisticated algorithms can generate the number of cattle in seconds, taking more time to print out the number than to actually compute it.

9:40 – 10:15 Ken Clements and Nerida Ellerton (Illinois State University), *Beyond Witches: Salem (MA), the Cradle of North American Mathematics*

We will argue from original documents (handwritten and printed), and other sources, that the particular environment that defined Salem in the late 18th and early 19th centuries generated an unusual culture – combining marine, mercantile and scholarly aspects – which gave birth to, and nurtured, modern mathematics in the United States. The lineage began with the remarkable Nathaniel Bowditch, and was continued through other Salemites, including Bowditch's distinguished protégé, Benjamin Peirce. The mathematics education side of the story will also be discussed and analyzed. One might ask: Why Salem (and not New York, or Boston, or Philadelphia)? Can anything good come out of Salem?

10:15 – 10:35 Break

10:35 – 11:10 Tina Hartley and Fred Rickey (United States Military Academy), *Why do we use "m" for slope?*

We don't know! But we know of no historical justification for the perennial claim that it comes from the French 'monter', or from any other hypothesis that is sometimes given. So what do we know? We have attacked the question of when the letter "m" and the word "slope" were used and can put temporal bounds on when they were first used. The earliest dictionary use of the mathematical word 'slope' occurs in the *Mathematical Dictionary and Cyclopedia of Mathematical Science* (New York, 1855) by Charles Davies and William G. Peck, so the word is older than this. However it does not occur in any eighteenth century book that we have examined. Rather than just dealing with the historically uninteresting question of who was first, we shall discuss the historical development of equations of straight lines and the more important question of why we introduce definitions at all.

11:15 – 11:50 Peggy Kidwell (National Museum of American History, Smithsonian Institution), *Problem-Solving as a Mathematical Recreation – The Case of Benjamin Peirce*

Perhaps the most enduring and most elusive form of mathematical recreation in the United States is the mathematical problem, posed as an entertaining challenge rather than a requirement of school or work. Such problems have intrigued mathematically minded people from young children to learned professors. They have appeared in almanacs, newspaper, and periodicals for people of many ages and abilities. Small magazines posing puzzles were the first periodicals in the U.S. devoted entirely to mathematics and the mathematical sciences. They served as a stimulus to students, a meeting point for a widely dispersed community of mathematically inclined Americans, and a way of disseminating ideas about mathematical elegance and accuracy. These early journals usually lasted only a few years, and had perhaps a hundred subscribers. However, they set a precedent for journals which continue to this day.

One useful lens for viewing the spread of mathematical problem solving in the nineteenth century United States is the career of Benjamin Peirce (1809-1880). From his undergraduate years at Harvard College, Peirce was actively involved in answering problems posed in mathematical periodicals. He also submitted problems, edited a journal for a time, and evaluated the solutions of others. Peirce in no way limited his mathematical activity to recreations – he taught mathematics at Harvard from 1831 until his death in 1880, wrote extensively on topics in mathematical astronomy and algebra, and spent some years as director of the U.S. Coast Survey.

Peirce's work in problem-solving has been considered by his biographer Edward Hogan and others. The mathematical journals important to him have been discussed by Benjamin Finkel, David Zitarelli, Deborah Kent and others. Nonetheless, it is appropriate to reexamine this aspect of Peirce's work as it sheds light on nineteenth century American mathematical pedagogy. More generally, I hope to stimulate discussion about how the recreation problem-solving relished by Peirce and others was associated with physical objects.

12:00 – 2:00 Lunch and business meeting

2:00 – 2:35 Semyon Litvinov (Penn State Hazelton) and Elena Litvinova (Bloomsburg University), *Methods of Solving Inequalities*

We offer a relatively comprehensive review of elementary methods of solving inequalities and show that the difference between solving equations and corresponding inequalities can be made practically negligible if one chooses to use the so called interval method.

2:40 – 3:15 Walter Meyer (Adelphi University), *Modernism As A Lens For Curricular History 1950-2000?*

The half-century from 1950 to 2000 was an eventful one in the teaching of undergraduate mathematics in the United States. We will give a short overview, based on various data sources, of what we consider the most important phenomena to have been. We will ask whether modernism (as recently featured in Jeremy Gray's *Plato's Ghost*), or its opposite countermodernism, make a useful summary of the main tendency of this era. An alternative characterization will also be considered.

3:30 – 5:30 Library visit

6:00-7:00 Social hour

<u>Sunday, March 13</u>

8:30 – 9:00 On-site registration (coffee and muffins)

9:00 – 9:35 Calvin Jongsma (Dordt College), *Much More than Symbolism: the Early History of Algebra and Its Significance for Introductory Algebra Education*

People in the history of algebra and in elementary algebra education tend to be overly partial toward success. Algebra is typically characterized by and admired for its use of symbolic notation and techniques. This is understandable, but focusing instead on algebra as the art and science of problem solving opens up new perspectives for mathematics teachers. Exploring the early history of algebra in several ancient and medieval cultures uncovers a number of less formal methods of problem solving that may help students better understand key ideas in algebra and even appreciate its final reorganization into a symbolic enterprise. My talk will present some material on this topic from two sections of a textbook I am writing about the origins and historical development of middle school and early high school mathematics. I have been using this material for the past several years in a course I teach to prospective middle school mathematics teachers, but I hope eventually to make it available to a broader audience.

9:40 – 10:15 Marina Vulis (Norwalk Community College), *Nikolai Lobachevsky and Russian Mathematics Education in the 19th Century*

At the beginning of the 19th century, school mathematics education in Russia was under the guidance of the mathematicians working at the Russian universities. One of the mathematicians directly involved in school mathematics education in Russia at the time was the famous Nikolai Ivanovich Lobachevsky. Lobachebsky paid special attention to teaching school mathematics. As President of Kazan University, he was also in charge of the Kazan Department of Secondary Education. Lobachevsky published textbooks on elementary algebra, geometry, as well on pedagogical aspects for mathematics . He was especially interested in interested in methods of teaching mathematics This presentation will demonstrate the important role of Nikolai Lobachevsky in Russian mathematics education.

10:15 – 10:35 Break

10:35 – 11:10 Ilhan Izmirli (George Mason University), *Does the Term Dark Ages Reflect Eurocentricism in Mathematics?*

Although it might be true that there was an overall stagnation in the practice of mathematics and natural sciences in Europe between 600 and 1200, an examination of the works of some Chinese, Indian, and Middle Eastern scholars of the same period, such as Aryabhata I (475 - 550), Brahmagupta (598 - 670), Bhashkara I(600 - 680), Li Chunfeng (602 - 670), Al-Jawhari (800 - 860), Mahavira (800 - 870), Thabit (836 - 901), Abu Kamil (850 - 930), al-Battani (850 - 929), Sridhara (870 - 930), Aryabhata II (920 - 1000), Abu-l Wafa (940 - 998), al-Quhi (c. 940 - c. 1000), Al-Khujandi (c. 940 - c. 1000), Al-Haitam (965 - 1039), al-Biruni (973 - 1048), Avicenna (c. 980 - 1037), Al-Jayvani (989 - 1079), Omar Khayyam (1048 - 1122), Brahmadeva (1060-1130), Bhaskara II (1114 - 1185), Qin Jiushao (1202 - 1261), al-Maghribi (1220 - 1280), al-Samarqandi (1250 - 1310), al-Banna (1256 - 1321), and al-Farisi (1260 - 1320), shows that natural sciences, medicine, philosophy, astronomy, logic, biology, and mathematics were thriving in those regions. In particular, it was through the works of Mohammad Abu-l-Wafa Al-Buzjani, Abu Ja-far Mohammad ibn Musa

Al-Khwarizmi, and Nasir al-Din al-Tusi, that several important concepts in modern plane trigonometry (such as constructing accurate tables of sine function and the use of the tangent function), spherical trigonometry (such as solving for parts of spherical triangles), the theory of equations (such as solutions of quadratic equations), and circular motion (cycloids), were either introduced or improved. It must be noted that, these scholars who were also prolific writers made several vital contributions to the fields of astronomy, logic, physics, and biology as well.

In this paper I will give examples of the works of al-Buzjani, Al-Khawarizmi, and especially al-Tusi to show that in the seven centuries that span the period 800 - 1500 C.E., mathematical sciences were able to sail along in a relatively uninterrupted manner and even manage to flourish through the innovative endeavors of these and some other non-European scholars.

11:15 – 11:50 Amy Ackerberg-Hastings (University of Maryland University College), *The Evolution of Mathematics Teaching Practices, c. 1770-1970*

In 1993, Alison King drew a distinction between the "sage on the stage" and the "guide on the side" approaches to the teaching-learning process that has since become so commonplace that it has passed into popular culture. As awareness of the points raised by King and other educational theorists is reduced to a simplistic "sage bad, guide good" dichotomy, casual observers may conclude that the lecture style of teaching has always been utilized in every classroom. However, efforts to foster learning in mathematics classrooms have been more varied and more complex. This paper provides an overview of the techniques employed by mathematics teachers to facilitate and to measure learning both during and after formal class time. The paper also charts some of the major changes in these instructional processes, such as in the structure of textbooks and in the forms established for homework and assessment. In unfolding this account, we will briefly note the historiographical challenges of determining what actually happened during daily routines in mathematics classrooms.