History of Mathematics from Medieval Islam to Renaissance Europe
Histoire des mathématiques de l'Islam médiéval à l'Europe de la Renaissance

(Org: **Rob Bradley** (Adelphi) and/et **Glen van Brummelen** (Bennington College))

CHRISTOPHER BALTUS, SUNY Oswego
When is a Negative Really a Negative?

Well into the 17th century, works in algebra commonly gave the rules for arithmetic involving negatives but did not allow negative solutions to equations. This paradoxical situation signals a less than full acceptance of negative numbers. I believe that the arithmetic rules, especially for multiplication, were intended for polynomial multiplication involving subtracted terms. I will speak of long term developments in this line of thought, from Brahmagupta and Islamic writers up to John Wallis.

LAWRENCE A. D'ANTONIO, Ramapo College, New Jersey
Number Theory from Fibonacci to 17th Century Safavid Persia: a question of transmission of knowledge

How much influence did Islamic mathematics have on Renaissance Europe and vice versa? This possible transmission of knowledge is an interesting and important topic for the historian. In this paper the question of transmission is examined with regard to selected problems in number theory, in particular the problem of congruent numbers. A congruent number k is an integer for which there exists a square such that the sum and difference of that square with k are themselves squares.

Congruent numbers can first be found in various works of classical Islamic mathematics, for example, in al-Karaji's early 11th century text, the *al-Fakhri*. Congruent numbers then resurface in the treatise *Liber Quadratorum* of Fibonacci. We then find congruent numbers in the influential 17th century work, *Khulasat al-Hisab* of Baha al-Din.

Was the work of Fibonacci known in the Islamic world? This is not easy to determine, since there is no direct reference to Fibonacci in Islamic sources. On the other hand, Edouard Lucas, in a major essay on Fibonacci, shows the existence of an intellectual thread, if not a clear historical thread, connecting Fibonacci and Baha al-Din.

To examine the problem of transmission, it is necessary to look at the cultural context for mathematics during the Safavid dynasty of 17th century Persia. The Safavid period represents, perhaps, the last flowering of classical Islamic science. Under the reign of the Safavid ruler Shah Abbas I, 1588–1629, a cultural renaissance occurred in the capital city of Isfahan. Especially important are Safavid accomplishments in the areas of mathematics, astronomy, scientific instrument making, carpet weaving, medicine, and architecture. Safavid mathematics is represented primarily through the work of Baha al-Din and Mohammad Baqir Yazdi (whose major work, the Uyun al-Hisab, also includes some interesting results in number theory).

It is well-known that many different Europeans spent time in the court of Shah Abbas. Adventurers, travelers, and missionaries were attracted by this center of learning. This paper examines possible sources of transmission. For example, it is known that the 17th century Italian traveler, Pietro Della Valle, did discuss current trends in astronomy with Persian scientists.

The discussion of the work of these Safavid scholars will hopefully contribute to a more complete picture of classical Islamic mathematics.

JOZSEF HADARITS, Royal Ontario Museum
Diamonds, Rings, and Squares: Eastern Magic in Western Hands

In medieval Islamic mathematics there were two basic methods for constructing odd-order magic squares: the so-called "diamond" technique and another, more sophisticated one that can be understood in terms of a virtual torus. The West produced the first detailed description of the latter technique during the Renaissance period. Using historical evidence, including that of art, this paper makes an attempt to trace some of the possible routes of this intercultural scientific reception—in order to get closer to the understanding of the cosmological-spiritual background of these centuries-old mathematical problems.

ODILE KOUTEYNIKOFF, IREM, Université Paris VII Denis Diderot
Guillaume Gosselin, an algebraist in Renaissance France

Guillaume Gosselin de Caen's treatise, known as *De Arte Magna* (Paris, 1577), is a short and quite simple work written by someone who is a typical algebraist in Renaissance France. Gosselin learned mathematics and heard about new methods in algebra from mathematicians who worked just before him; after making these new methods his own, he wanted them to be taught and wrote them down. He is especially good at solving problems with several unknown quantities and several linear equations.

It is important to notice that Gosselin's book is very dependant both on Italian Tartaglia's *Arithmetic* (Venise, 1556), which Gosselin translated into French by the same time he wrote *De Arte Magna*, and on Diophante's *Arithmetics*, which came to be known exactly two years before, thanks to Xylander's translation into Latin (Bâle, 1575). Both Gosselin and Tartaglia refer to Pacioli's work (*Summa*, Venise, 1494) and Pacioli himself says he learned much from Fibonacci, especially through *Liber Quadratorum* (Pise, 1225).

According to the fact that Al-Khwarizmi founded Algebra during the 9th century, it is not surprising that, when being translated into Arabic in the late 9th century by Lebanese Ibn Luqa whose native language was Greek, Diophante's *Arithmetics* seemed to be considered as a treatise about Algebra since algebraic vocabulary and way of thinking were most widely shared. Only few people understood that it was actually an arithmetic treatise: Al-Khazin (900–971) did, and therefore he is one of those who laid the foundations for the integer Diophantine analysis. We know that Jean de Palerme submitted Al-Khazin's problem about congruent numbers to Fibonacci, who then wrote *Liber Quadratorum*.

These are the main ways that lead from Diophante, as both a Greek and an Arabic source, to Renaissance Europe readers. We will show from his text how eager to learn and respectful of what he learnt Gosselin was, and how enthusiastic about the new algebraic methods he was too. He wished he could retranslate and explain the complete Diophante's *Arithmetics*, but he didn't. We ignore what kind of work he would have done, either an exact arithmetic treatise as Bachet (Paris, 1621) and Fermat (1601–1665) did, or an up-to-date algebraic one according to what all algebraists did, such as Bombelli (*Algebra*, Bologne, 1572), Stevin (*Arithmetic*, Leyde, 1585), Viete (*l'Art Analytique*, Tours, 1591–1593) or Girard (*L'invention nouvelle en Algèbre*, Amsterdam, 1629).

FEDERICA LA NAVE, Harvard/Dibner Institue
Bombelli and L'Algebra

In *L'Algebra*, Bombelli was the first to recognize what we call "imaginary numbers" as numbers, and to give them operative definitions. *L'Algebra* was published in three books in 1572. However, Bombelli wrote the first version in five books in 1550. In the 1550 manuscript version Bombelli does not believe that the roots born in solving cubic equations in the irreducible case are numbers. In the published version he believes they are numbers and gives rules for operating with them. The aim of this paper is to try to understand what happened in these twenty-two years to Bombelli's state of belief—how his beliefs changed and what caused that change.

GLEN VAN BRUMMELEN, Bennington Collge
Al-Samaw'al and the Errors of the Astronomers: Where the Mistake Really Lies

Ibn Yahya al-Maghribi al-Samaw'al, a 12th-century converted Jew most known for his contributions to an arithmetical revolution in algebra, also wrote an intriguing but rarely studied book entitled *Exposure of the Errors of the Astronomers*. In it he takes shots at many of his predecessors, as far back as Ptolemy, for choices that they had made in their astronomical methods. Some of his criticisms seem odd, almost off the wall to a modern reader, but perhaps there are lessons here for an understanding of the medieval scientific mind. We shall explore some of his criticisms and attempt to put into historical context the rationality behind his criticisms.