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# History of Mathematics

Math 395 Spring 2010  
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Fowler 310 MWF 10:30am - 11:25am  
<http://faculty.oxy.edu/ron/math/395/10/>

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## *Class 21: Monday March 29*

**TITLE** Mersenne, Descartes, Pascal, Fermat, and Galileo!

**CURRENT READING:** Katz, §13

**NEXT READING:** Katz, §14

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**Homework #8 DUE Friday April 2 (in class)**

**Katz, p. 418: #4, #8, #21, #30, #37. EXTRA CREDIT: page 419, #29.**

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### **SUMMARY**

We will discuss the lives of these famous mathematicians and scientists in the first half of the 17<sup>th</sup> Century.

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**Marin Mersenne** (1588-1648) was the link between some of the most famous scientific/mathematical names of all-time: Galileo, Pascal, Descartes, Huygens and Fermat.

Mersenne corresponded with all of these mathematicians and has been described as a “walking scientific journal” (Katz 477) since generally people would send him a letter containing their latest results and he would forward a copy to each member of the group. This group formed the core of what would become an institute of the French Academy in 1666.

### **René Descartes (1596-1650)**

Descartes is known as “the father of modern philosophy” for the ideas published in his 1641 book *Meditationes*. His most famous book may be *Discours de la méthode pour bien conduire sa raison et chercher la vérité dans les sciences* (Discourse on the Method of Reasoning Well and Seeking Truth in the Sciences) of 1637. He postulated that the entire universe is made up of matter in unending motion in vortices, and that all observed phenomena can be explained in terms of the forces exerted by adjacent matter. He is also well-known for the saying “I think therefore I am” (*Je pense donc je suis* or *cogito ergo sum*)

Descartes is also known as the father of analytic geometry (the intersection of algebra and geometry) for his use of what is now called the Cartesian coordinate system. In one of the appendixes of *Discourse* called *la géométrie* he demonstrated his new method. Descartes would take a geometric problem (like finding the tangent to a curve or the locus of points related to a number of lines). Descartes would convert the given geometric problem into an algebraic problem but then he would often use geometry to solve the algebraic problem. He saw geometry and algebra as two sides of the same coin.

### **Blaise Pascal (1623-1662)**

Pascal was a child prodigy who presented his first paper at the age of 16(!) to Mersenne’s group, where everyone was impressed with the youngster and his contribution except for Descartes, who was dismissive and insisted that it must have been written by Blaise’s father, who was also mathematically inclined.

Pascal is most well-known for “Pascal’s Triangle,” although its existence had been known for at least six centuries at this point. Pascal did identify some new properties, and more importantly proved some of them using a technique which we now know as **mathematical induction**.

Pascal was very religious and gave up doing mathematics to concentrate on religious philosophy. During brief breaks from these pursuits he proved that a vacuum could exist and other scientific results which led his name being associated with the scientific unit of pressure, pascals.

### **Pierre de Fermat (1601-1665)**

Fermat is Descartes main rival to mathematical ability during this era but he was not a professional mathematician or scientist but a lawyer and politician who merely dabbled in these subjects as an avocation or hobby. Fermat made great strides in analytic geometry as well, writing (a year before Descartes published *Discourse*):

**Whenever in a final equation two unknown quantities are found, we have a locus, the extremity of one these describing a line, straight or curved.**

Basically, Fermat is describing the set of solution of  $f(x,y)=0$  represent planar curves.

Fermat is most well-known for his contribution to number theory, primarily “Fermat’s Last Theorem” and Fermat’s “Little Theorem.” In a letter (to Mersenne, of course) Fermat proved that  $2^n-1$  can not be prime if  $n$  is not prime. The primes which have the form  $2^p-1$  where  $p$  is prime are now known as **Mersenne primes**. Fermat’s Little Theorem is “If  $p$  is any prime and  $a$  is any positive integer, then  $p$  divides  $a^p-1$ , or  $a^p \equiv a \pmod{p}$ .”

Fermat’s Last Theorem is that there do not exist non-zero integers  $a$ ,  $b$ ,  $c$  and  $n$  (for  $n>2$ ) such that  $a^n+b^n=c^n$ . Fermat was quite mischievous, and he claimed that he had a “truly marvelous demonstration [of this result] which this margin is too narrow to contain.” The statement of the result is so simple that it captured the imagination of mathematicians everywhere but was not proven until 1995 by Andrew Wiles of Princeton using mathematician techniques that were not invented until hundreds of years after Fermat’s death! Fermat was not flawless however. He repeatedly claimed that all number of the form  $2^{2^n}$  were prime but Euler showed that  $2^{2^{25}}+1$  was not in 1732.

### **Galileo Galilei (1564-1642)**

Galileo is most well-known for his *Dialogue Concerning the Two Chief World Systems* in 1637 which he presents the arguments for and against the Ptolemaic and Copernican views of the solar system through the dialogue between two students, one smart and one not so smart, and a teacher. By the end of the book, the mutually agreed upon view of the solar system is clearly resembles a heliocentric model of Copernicus. This led to conflict with the Catholic Church, which in 1633 banned the Dialogue and compelled Galileo to appear before an Inquisition in Rome and forced him to “confess his error.” After the trial Galileo was sentenced to house arrest and prohibited from publishing any more work. Happily, he was able to publish *Discourses and Mathematical Demonstrations Concerning Two New Sciences* in 1638 and circumvent the publication ban by sending the manuscript to the Netherlands.

Galileo made several discoveries related to kinematics which he was able to support with experiment and describe geometrically.