Medieval Perspective

- Euclid’s elements were translated from Arabic into Latin in 1142 by Adelard of Bath, al-Kwrorizimi’s algebras were translated in 1151 by Robert Chester.
- A “small of army” of translators was lead by Gerard of Cremona (1114-1187) after Toledo was conquered from Arab empire in Spain, including Archimedes treatises on measurement of the circle and the sphere. In 1269 William of Moerbeke published a Latin translation of the extant Greek corpus of Archimedean treatises. Comment: too sophisticated for immediate widespread assimilation.
- What Edwards calls medieval speculation took place in monasteries, cathedral schools, and universities University of Bologna (1088), the University of Paris (c. 1150, later associated with the Sorbonne), the University of Oxford (1167), the University of Palencia (1208), the University of Cambridge (1209), the University of Salamanca (1218), the University of Montpellier (1220), the University of Padua (1222), the University of Naples Federico II (1224), the University of Toulouse (1229), the University of Siena (1240).
- Philosophical and scientific started out from theological arguments, as “background” knowledge, also as rudimentary art of argument including logic and rhetoric. Authorities were important, Aristotles as the Philosopher, Paul the Apostle and Richard Swineshead “the calculator” (from Merton college, successor of Bradwine in 14th century).
- One main aspect of Aristoteles philosophy is everything carries within himself the purpose to develop or move to a purpose. Aristoteles challenged scientific community to discuss motion, continuity and infinity (Book III, Chapter 1). Continuity and infinity were often connected as characteristics of the continuum.
- Key words: qualities, lattidue of forms, intensive and extensive qualities, total motion.
- Mathematically more interesting velocity, motion, and instantaneous velocity. No limits, but arguments based on intuitive understanding of moving objects.
Merton’s school arrived at the following theorem:

If a moving body is uniformly accelerated during a given time interval, then the total distance traversed is that which it would move during the same interval with a uniform velocity equal to the average of its initial velocity and the its final velocity (namely, its instantaneous velocity at the midpoint of the time interval).

This was formulated in the Treatise on the Configurations of Qualities and Motions written 1350’s, and communicated to France and Italy. Nicole Oresme added an illustration of this fact.

\begin{itemize}
  \item Application: The law of the odd numbers. Let \( s_j \) be the distances traveled after time \( j \) and \( v_0 = 0 \). Then \( s_j/2j + 1 = \text{constant} \).

  Proof: Step 1: We prove \( s(t) = v_0 t + 1/2at^2 \). Indeed, for fixed \( t \), we know that \( v_f(t) = v_0 + at \) and hence

  \[ s(t) = v_{ave}t = \frac{v_0 + v_f(t)}{2}t = v_0t + \frac{at^2}{2}. \]

  Step 2: For \( v_0 = 0 \) and \( t_j = cj \) we get

  \[ s_j = s(c(j+1)) - s(cj) = a((j+1)^2) - aj^2 = a(2j+1). \]

  Hence \( s_j/s_1 = 2j + 1 \). -The law of odd numbers.

  In Oresme “treatise on Configurations” introduced four new ideas:

  (1) measurement of physical variables in terms of line segments (even area)
(2) a precursor of a functional relationship of certain variables as a function on time.

(3) graphical or diagrammatic representation

(4) Representing distance travel as area under trapezoid.

Oresme work also served as a reference point for later work by Galileo. Edwards talks about the origin and subsequent influence of the medieval geometry of motions.
Medieval Infinite Series Summation

• Swineshead observed that

\[ \sum_{n=1}^{\infty} \frac{n}{2^n} = 2. \]  

He gave a long verbal proof using velocity (in Archilles and the turtle style) (see page 91).

• Oresme in 1350 not only observed

\[ \sum \frac{a}{k}(1 - 1/k)^n = a, \]

used similarly as in Archimdes quadrature of the parabola, but also gave a geometric proof of (1). (Also Read paragraph on page 93.)