Classical Mathematics After Archimedes :

- Syracuse fell to the Romans (212 BC)   ⎫
- Carthage fell 146 BC   ⎪ Roman
- Caesar conquered 40 BC   ⎬ Empire
- Anthony & Cleopatra fell to Octavia in 30 BC ⎭ Begins

Ancient
Romans were a practical (engineering) people who did not have
              a taste for pure mathematics.

  - No great Roman Mathematician mentioned in Dunham.
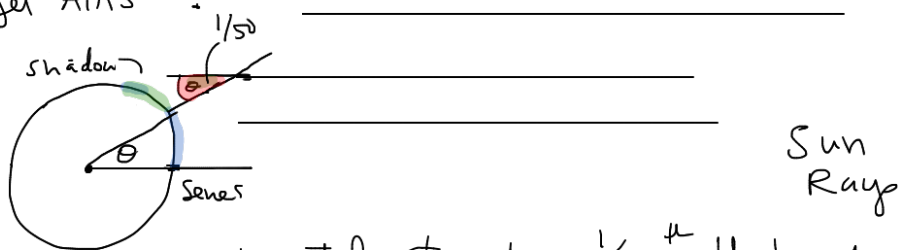
Library at Alexandria :
        -. Romans eventually control (30 BC) many of the
            scholars there were forced to evacuate. they did,
            & spread knowledge teaching.

Eratoshenes (284-192 BC)
      - Machine
      - Sieve for finding primes (Dunham)
      - Accurate measure of circumference of the Earth.

B/c parallel, get AIA's =.

shadow
Sener

Sun
Rays

1. Angle θ was estimated to be $1/50^{th}$ that of a full revolution

2. How far from Sener to Syracuse? 5000 "stades"
                                            └ stadium
                                            └ 516.73' = 1 stade

So: $\dfrac{5000}{Circumference} = \dfrac{1/50}{1}$

     $Circumf = 5000 \times 50 = 250000$ stades
                        ≈ 24,466 miles

                    24,860
                    actual

During the Roman rule,
   Mathematical progress was slow

- classical works of Euclid, et tal were
  kept by the Arabians. (Baghdad)

- the Muslim inhabitants studied these classics.

- One bit of progress: Hindu-Arabic numeral system.

    BTW — The mathematics of India during this period
      0 — 1000 CE   was   superior to   European Mathematics

- Al-Khowarizmi — Al'jbr. (although no symbol manipulation
                                              — there was
400 CE   (beginning of algebra)   verbal descriptions)
                                                 of solving
                                                    algebraic problems.

                    Attempted
- Crusades: Christian   of Middle East (11 — 13th Century)
                    Conquest

     Christian Conquest
           of
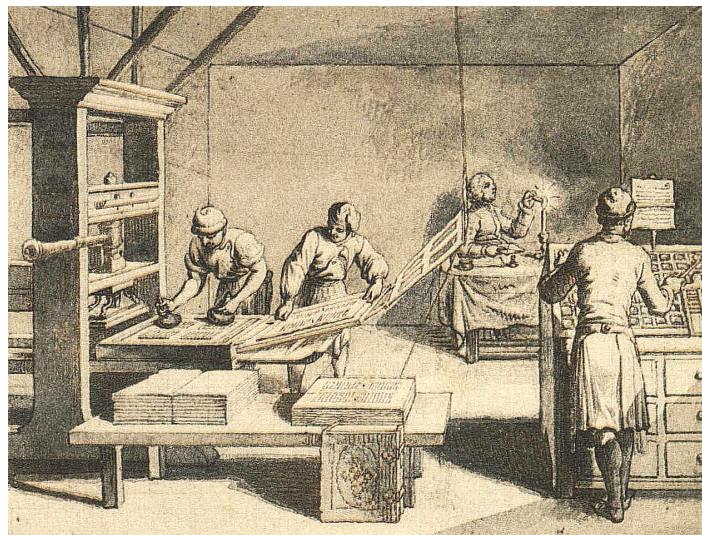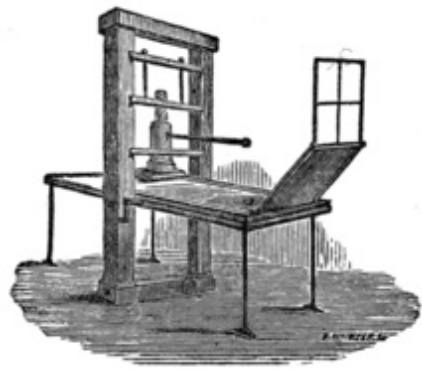- Moors: _____ (spain / sicily)
         _____ found classical works.
         _____ this began the Renaissance.
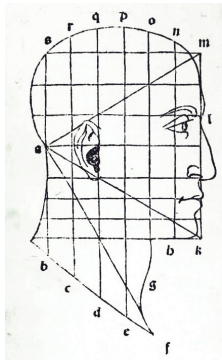
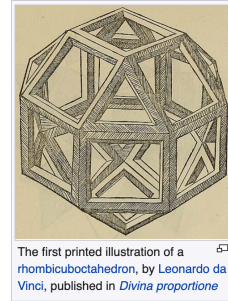Medieval university class (1350s)

1440

Renaissance

3600 pages per day

1492

Luca Pacioli

1494

The first printed illustration of a
rhombicuboctahedron, by Leonardo da
Vinci, published in *Divina proportione*

Luca Pacioli
▼ 1. Published Divina Proportione
    a. On math / perpsective /
       golden ratio
    b. Da Vinci made the
       illustrations
▼ 2. Published Summa de
    Arithmetica
    a. solve linear/quadratics
    b. primitive symbolic algebra:
       co = cosa = thing
   3. Wrote: the general cubic
      equation is unsolvable

$$ax^2 + bx + c = 0 \quad (\text{quadratic formula})$$

$$ax^3 + bx^2 + cx + d = 0$$

similar ?

$$x = \sqrt[3]{\left(\frac{-b^3}{27a^3} + \frac{bc}{6a^2} - \frac{d}{2a}\right) + \sqrt{\left(\frac{-b^3}{27a^3} + \frac{bc}{6a^2} - \frac{d}{2a}\right)^2 + \left(\frac{c}{3a} - \frac{b^2}{9a^2}\right)^3}}$$

$$ + \sqrt[3]{\left(\frac{-b^3}{27a^3} + \frac{bc}{6a^2} - \frac{d}{2a}\right) - \sqrt{\left(\frac{-b^3}{27a^3} + \frac{bc}{6a^2} - \frac{d}{2a}\right)^2 + \left(\frac{c}{3a} - \frac{b^2}{9a^2}\right)^3}} - \frac{b}{3a}.$$

Leonardo da Vinci's failed attempt to solve $x^3 = 2$

$$7x^3 + 5x = 5$$

Scipione del Ferro
Born: 1465

del Ferro

▼ 1. Father worked in paper industry
   a. Possible b/c printing press
   b. This likely gave del Ferro access
▼ 2. Depressed Cubic: Cube and cosa equals number
   a. Solved it!
   ▼ b. Didn't tell
      i. Save the solution for challenges
▼ 3. Daughter married a mathematician
   a. undoubtedly knew of Scipione's solution
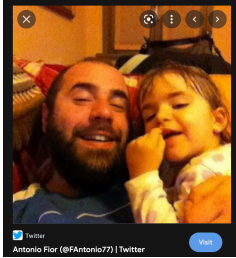4. On deathbed, told his student, Antionio Fior

$$ax^3 + bx^2 + cx + d = 0$$

depressed
↓

$$ax^3 + cx = d$$

Antonio Fior

1. Student of del Ferro
▼2. Challenged Niccolo Fontana (b. 1500) to a duel
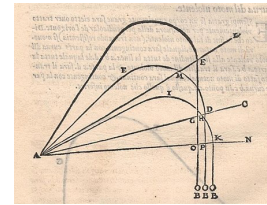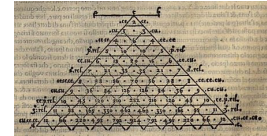   a. armed with ONLY the solution of the depressed cubic

Antonio Fior (@FAntonio77) | Twitter

$$x^3 + mx = n$$

Niccolò Fontana Tartaglia: Italy 1500 - 1557

"stammerer"

Tartaglia

1. Powerful mathematician
2. 1st Italian translations of Euclid & Archimedes (1st correct Europena version of Elements)
3. Studied ballistics
4. Tartaglia eked out a living teaching practical mathematics in abacus schools and earned a penny where he could:

> "This remarkable man was a self educated mathematics teacher who sold mathematical advice to gunners and architects, ten pennies one question, and had to litigate with his customers when they gave him a worn out cloak for his lectures on Euclid instead of the payment agreed on."

Begged Tartaglia for the solution

Pacioli: 1450

— solved depressed cubic
 — told no one (only Fior)
 (son in law
 was Mathematician)

Scipione del Ferro: 1465

?

Antonio Fior: 1506

1st Italian
translation
of Euclid
and Archimedes

— also (independently)
 solved depressed cubic
— Didn't want to share, eventually did —— in 4 Poems
 —— Forced Cardano not to share.

Niccolò Fontana Tartaglia: Italy 1500 - 1557

— wild man
— begged Tartaglia for
 depressed cubic sol'n.
— eventually has student
 & they travel to library
 where they find
 Del Ferro's Sol'n
 (son-in law)
— Felt he was 'off the
 hook' on sharing.